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FOUNDED APRIL 1891

INDUSTRIAL MANAGEMENT

THE ENGINEERING MAGAZINE

Edited by John R. Dunlap and L. P. Alford

War Protection for Industrial Plants

Duties of Employers in Protecting Factories Against Sabotage

Hon. Thomas W. Gregory, Attorney General, U. S. A.

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Bring Down Your Steam Cost In Spite of High Coal Prices

WHAT THE U. S. FUEL ADMINISTRATORS SAY!

To Owners of Industrial Plants

"Every steam plant consuming five (5) tons of coal per day should employ some adequate method of checking its boiler and furnace efficiency.

"The price of ignorance is waste. These must be replaced by *Knowledge and Efficiency.*

"There are, broadly speaking, *two methods of checking boiler room efficiency.*

"1—Daily accurate measurements of coal and feed water.

"2—Systematic flue gas analysis."

There are TWO METHODS for checking boiler room efficiency, but there is only ONE METHOD for checking furnace efficiency.

CO_2 Recorder for Chief Engineer's Office.

UEHLING CO_2 Recording Equipment

continuously measures the CO_2 in waste gases. It gives you permanent records which are of invaluable assistance. In addition, auxiliary CO_2 indicators at the boiler front act as guides to your fireman. This is what the U. S. Fuel Administrators mean by SYSTEMATIC FLUE GAS ANALYSIS.

The Fuel Administrators then continue:

"Both methods should be employed in a plant of large size.

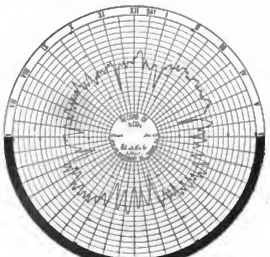
"You are requested to place your boiler plant under as careful a system of Accounting and Supervision as any production department of your business.

"Nothing will more effectively assist your firemen in getting high results from the coal than to provide means for determining what results he is getting.

"*Call in a competent fuel engineer, if necessary, in order to advise and instruct you in the installation and efficient use of a suitable system for your plant.*"

(*Signed by*)
UNITED STATES FUEL ADMINISTRATION

Referring to the last paragraph in their statement, we offer our wide experience to assist you in matters of fuel and combustion efficiency. Combustion engineering is our specialty. Your combustion problems will receive our close and prompt attention.



Typical CO_2 Record on 8-inch chart.

Uehling CO_2 Meters and Combined CO_2 and Temperature Machines are made up in various styles and combinations to meet any requirement. Our engineers are ready to take up your combustion problem now. Write.

CO_2 Machine.

CO_2 Indicator for mounting in boiler room.

Uehling Instrument Company

Combustion Engineers

2003 Empire Bldg. New York City

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Cost-Keeping Is A Science:

Practical cost systems that constantly influence cost reduction are the result of experience.

Gunn, Richards & Co.

New York

Boston *Montreal*

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DAY & ZIMMERMANN
INCORPORATED
PHILADELPHIA

FOR three years Industrial America has been working at high pressure and it has yet to meet enormous demands in the present year and years to come. Despite insistent warnings to "Prepare," our entry into the World War found much confusion and disorganization among industrial plants and many manufacturers still find themselves hampered by the inadequacy of plant layout and facilities.

Engineering and Construction

We offer you through our organization the services of experts well versed in layout, design and construction, each thoroughly familiar with every detail of his subject from practical experience, supplemented by abundant data gathered through years of study and accomplishment.

Whether your problem involves the expansion of your present plant, the construction of an entirely new one or the adaptation to your requirements of a ready built plant, the wide and varied experience of our organization in handling industrial projects will be valuable to you.

Reports

Not only are the investor and purchaser becoming more and more prone to require a report from competent engineers before becoming financially involved, but the manufacturer has come to believe that the advice of the engineer is as essential to the cure of industrial ills as are the services of the specialist to the cure of bodily ills.

Our Report Department has the benefit of the practical experience of our entire organization and is thus peculiarly well fitted to render an authoritative opinion.

Appraisals

A well equipped and experienced Appraisal Department is at your service to make a reliable valuation of your plant, such as you may be called upon to produce for taxation, financing, arrangements for Government control, partnership adjustments, insurance, etc.

The availability of such an appraisal, made by disinterested engineers of well-known standing, frequently proves of great advantage and saves much valuable time.

Audits

In response to the requests of numerous clients who have known of our Department of Audits in connection with our Report work and Public Utility management, we are prepared to audit accounts and give advice concerning organization or re-organization problems.

ENGINEERING - CONSTRUCTION
REPORTS - AUDITS - APPRAISALS

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INDUSTRIAL MANAGEMENT

TABLE OF CONTENTS—MARCH

DIVISIONS OF THE ENGINEERING INDEX

THE ENGINEERING MAGAZINE CO., PUBLISHERS

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DIVORCE THE COAL & ASHES

For ultimate economy, coal and ashes should be handled separately.

Coal is semi-graphitic.

Ashes are highly abrasive, and can be red-hot or wet.

With separate systems, each system can be the best for its purpose, and can be separately repaired.

In the boiler house shown, a bucket elevator carries the coal from an underground crusher to the bunker.

The ashes are drawn from hoppers under the boilers into a push car and dumped without crushing into the skip bucket. The bucket ascends, dumps and returns automatically, while the operator gets another load.

One man looks after both systems and has spare time besides.

Abrasive wear from ashes is limited to the car and skip bucket——both cheaply replaced.

Power for both systems is small.

Modernize Your Boiler Room

We are installing coal and ash handling machinery in many existing plants to meet the labor shortage.

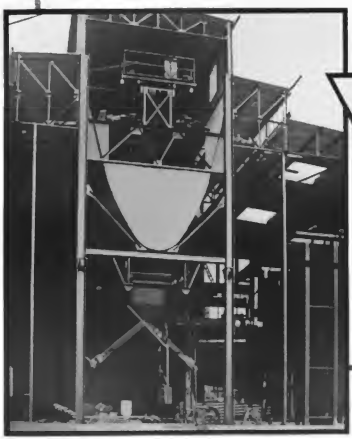
Send sketches of your boiler room layout and we will tell you what can be done. Often very little change is needed.

R. H. BEAUMONT CO.

426 Chestnut St., Philadelphia, Pa.

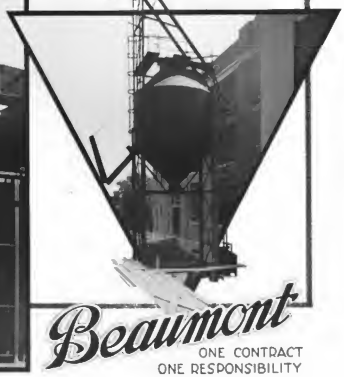
New York: 50 Church St. Boston: 141 Milk St.

Specialists for 25 years in Coal, Ashes and Coke Handling Equipment for Boiler and Gas Houses



Phila. Suburban Gas & Electric Co. Cromby, Pa.

Suspension Bunker, feeding by weigh larry to boilers. Skip Hoist and bunker for ashes, fed by dump car from ash hoppers.



Beaumont

ONE CONTRACT
ONE RESPONSIBILITY

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Important Articles in the April Issue

Handling Shells in British Shops — By Frederick G. Zimmer

When British women began to make shells it was necessary to provide hoisting, handling and transporting devices such as had never been required before, because of the difference in physical strength between women and men operators. That same problem is now facing American manufacturers. This article will show many of the successful British devices that can be adapted on this side of the water.

Economics of Electric Trucking — By F. C. Myers

One way to increase our productive industrial force is to release men from work that can just as well be done by machinery or mechanical devices. There are many American factories that are just beginning to study the economics of trucking and Mr. Myers has drawn helpful illustrations from a number of plants.

Graphic Control of Production — By C. W. Starker

It is easier to see than to think. If the need for action can be determined by merely looking at facts visualized on charts the mental effort is far less than if these same facts in some other form must be grasped by the brain, placed in their proper relation one to another and the conclusion reached through hard thinking. It is possible to obtain graphic control of production—and with a minimum of mental effort.

Mastering Power Production—IV — By W. N. Polakov

This installment begins a careful presentation of the functions and duties of labor in the economical generation of power.

Employees' Benefit Association—IV — By W. L. Chandler

This fourth section of Mr. Chandler's series takes up the two important general questions, What benefits are just? and How should the beneficiaries be supervised?

The Generation of Power — By W. Rockwood Conover

A discussion of power generation from the particular viewpoint of the factory economist. The importance of such a consideration at the present time is in the minds of every one because of the fuel conditions that have existed in the Eastern half of the country during the first three months of the year.

International Standardization — By Herbert T. Wade

Because of the advisability of having many parts of items of war material produced in this country duplicate similar parts of French and British manufacture, we have the beginnings of international standardization of the proportions of machine parts. A little imagination helps us to picture the advantages of continuing this process during the years of peace. The principle that should be followed and the basis upon which the work should be started are outlined by Mr. Wade.

Depreciation in Industrial Appraisement — By Charles W. McKay

There are four principal causes for the depreciation of industrial property. There are recognized methods for determining each. The importance of this subject to industrial managers can hardly be exaggerated.

Instituting Standard Factory Practice — By Willard S. Worcester

First the preparation of standard practice and instructions, with information as to their application and use, and second the means and methods used to put these into effect in industry.

Personnel Administration of the Thomas A. Edison Interests — By Mark M. Jones

One of the strongest personnel organizations in the United States is that which handles employment, rate setting, betterment service, safety and health matters for the plants comprised in the group of the Thomas A. Edison interests. In the April number will be the first installment of a series of articles written by Mr. Jones, Supervisor of Personnel, giving the policy, methods and results of the work of his department.

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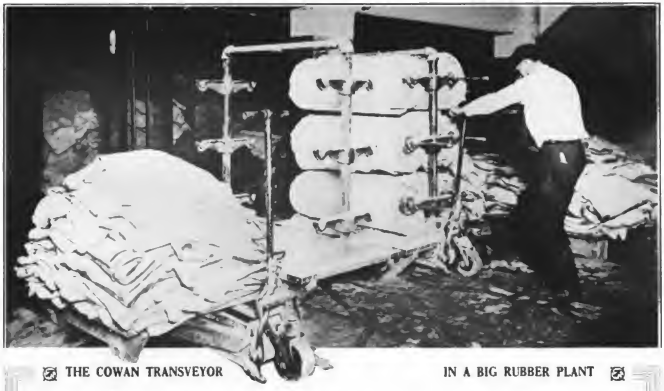

THE COWAN TRANSVEYOR IN A BIG RUBBER PLANT

Magnifying Man Power

HOW to keep up production at home while maintaining an army abroad—that is the big problem confronting industrial managers. With the remaining man power, each pair of hands must perform the labor of a dozen.

The Cowan Transveyor

is the manager's "first aid" in time of war, as in time of peace. The Transveyor will unload or load freight in the least possible time; it will keep the materals "in process" on the move; it will enable a single man to lift and transvey loads of from 2,000 to 5,000 lbs. with ease and dispatch.

The Cowan Transveyor is the pioneer elevating truck, now used by over 12,000 concerns. It is the big, demonstrated success in its field. It revolutionized the entire process of factory trucking, and has the "trump card" of industrial efficiency experts.

Each platform is a truck.

The Cowan Transveyor is strictly high grade in design, material and construction. The wide distribution and extensive selling organization made prompt personal attention possible in every section of the country.

We have collected much valuable data relating to trucking in every kind of business, this is at your disposal. You should, of course, have a copy of The Cowan Transveyor catalogue for reference.

COWAN TRUCK COMPANY

Makers of Cowan Transveyors

53 Water Street HOLYOKE, MASS.

AWARDED GOLD MEDAL—PANAMA-PACIFIC EXPOSITION 1915

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Where Advertiser and Publisher Shake Hands

HITS OR MISSES

A RIFLE bullet is a very small piece of metal. Yet if a rifle bullet hits any one of many vital parts in a man's body, the man dies.

It is estimated that 360 pounds of rifle bullets are shot away in this war for every soldier killed by rifle fire. That is, at least twice a soldier's weight in bullets must be shot at him to make the one fatal hit.

For each hit there are a multitude of misses.

Business success comes from acts that "get there"—hits—not from half-hearted tries and mistakes—misses—although the latter may yield useful lessons.

Advertising is printed with a purpose—to influence the selection and purchase of articles and service. To exert this influence advertising must be read by men who are in a position to select and buy. When such men read your advertisement you have made a hit—when other men turn over your display in the pages of a technical journal you are having misses.

You cannot hit a man by aiming your rifle at a tree trunk.

You cannot exert the influence aimed at through your advertising unless your printed pages are opened before the eyes of the men you want to reach.

The equipment, materials and supplies used in industry, and the expert service that advances industrial progress, are selected, purchased and paid for by industrial executives and mechanical engineers. If you are marketing any of these things you must display your advertising before these groups of men who are responsible for industrial results.

In journalistic parlance such responsible executives are referred to as "quality subscribers." With pardonable gratification we are able to announce that analysis of the subscription list of INDUSTRIAL MANAGEMENT shows that more than 87 per cent. of our subscribers are responsible industrial executives: Presidents, vice-presidents, secretaries, treasurers, general managers, general superintendents, mechanical engineers, chief engineers, master mechanics and purchasing agents of industrial plants.

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War Re-Organization

¶ Business is both production and distribution. SO IS WAR. In business, they are separate and distinct. THEY SHOULD BE SO IN WAR. This spells an absolute divorce between the Military (the distribution function) and the Industrial (the production function) branches of our War-Machinery: each under separate control, yet BOTH CO-ORDINATED AND MANAGED BY STRONG EXECUTIVE ADMINISTRATION.

¶ As it is now, the military and industrial branches are too closely merged. Place military-trained men over business-trained men who are in uniform, and YOU ROB BOTH OF THEIR GREATEST EFFECTIVENESS, because you make the military man responsible for things he doesn't know about; and you give the business man no authority. Without authority, no substantial results are possible.

¶ Separate the two. Place the strongest man to be found in charge of the logical division — CHOOSE MEN LIKE SCHWAB, ROOSEVELT, STETTINIUS, FARRELL, GOETHALS and HURLEY.

¶ Close study, based upon intimate discussions of the subject with thousands of business men all over the country, led me to work out with the help of my Associates, the chart on the following page — which while offered as a tentative suggestion only, may bring about prompter and more direct results that will afford much-needed reforms in our war administration.

C. E. Knoeppel

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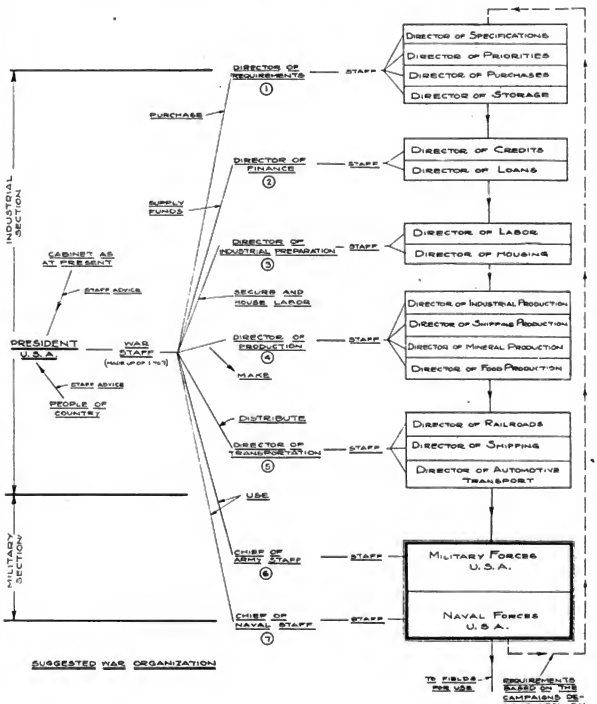
A Suggested War Organization

By C. E. KNOEPPEL

(Chart is self-explanatory)

JANUARY 26, 1918



SUGGESTED WAR ORGANIZATION

C. E. KNOEPPEL & CO., INDUSTRIAL ENGINEERS, NEW YORK

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The PNEUMERCATOR SYSTEM IN INDUSTRY—No. 2

ON GUARD AGAINST INCENDIARIES

You install an automatic sprinkler system to protect your property.

Without water in your tanks, this is worse than useless, because you ***think you are safe when you are not.***

How do you know your tanks are full — or empty — maybe they are frozen.

A Pneumercator system will show you right in your office their condition at all times—or automatically notify your engineer as to the water level.

Used by General Fire Extinguisher Co. on both wet and dry systems. Approved by Underwriters Laboratories as Standard Equipment for Sprinkler Service.

Send for Booklet—
"The Pneumercator Ashore."

THE PNEUMERCATOR COMPANY, INC.

118 Liberty Street New York

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UNION SWITCH & SIGNAL COMPANY
BUILDING "A"
500 FT. x 80 FT. x 83 FT.


UNION SWITCH & SIGNAL COMPANY
BUILDING "B"
500 FT. x 80 FT. x 83 FT.


WESTINGHOUSE LAMP COMPANY
501 FT. x 82 FT. x 70 FT.


B. F. GOODRICH COMPANY
359 FT. x 101 FT. x 106 FT.


INVESTMENT LAND COMPANY
278 FT. x 207 FT. x 96 FT.

How do these INDUSTRIAL BUILDINGS compare with your own needs?

The floor areas vary from 204,000 square feet to 420,000 square feet. They are large structures.

Our recent work has included a wide variety of interesting buildings and plants of all sizes meeting many needs.

Send for our book
"BUILDING CONSTRUCTION"

STONE & WEBSTER

NEW YORK
120 Broadway

BOSTON
147 Milk Street

CHICAGO
First Nat'l Bank Bldg.

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A "Five Foot Shelf"

For Business and Professional Men

TWENTY years ago there were very few books on accountancy, industrial engineering and related business topics. The difficulty was to find anything really worth reading.

Today there are hundreds—literally. One well known list compiled in 1916 carried 1,600 titles. A new edition this year contains 2,160 titles, although it is still called "1600 Business Books." The difficulty today is to select what is most worth while.

To meet this need for our own organization we have compiled a carefully selected list of helpful useful books. The titles are grouped in the following classes:

Accounting	Commercial Law
Cost Accounting	Business
Auditing	Advertising
Industrial Management	Handbooks
Banks and Banking	Other Special Subjects
Municipalities	Depreciation and Valuation

Relations of Employers and Employees.

These volumes vary widely in quality. Some are the product of able scholars or men with broad professional experience; some are common-place little manuals hammered out from the practical experience of every day work. All can be of value if used in the right way.

We will send a single copy of this book list on request to any executive who will return the following coupon completely filled out. Additional copies 25 cents each.

SW&Co CERTIFIED PUBLIC ACCOUNTANTS MARK AND NEW YORK

Scovell, Wellington & Company

Certified Public Accountants
Industrial Engineers

A National Organization for Constructive Service

Boston, 110 State Street **Springfield, Mass., Stearns Building**

New York, Woolworth Building **Cleveland, Illuminating Building** **Chicago, 10 South La Salle Street**

Scovell, Wellington & Company
110 State Street, Boston, Mass.

Please send me your book list, A "Five Foot Shelf" for Business and Professional men.

Name _____ **With** _____
(Official Position) (Company)

Our products are _____

No. _____ **Street** _____
(City) (State)

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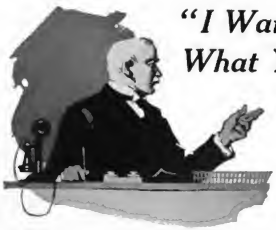

"I Want to Know What Your Users Say About It"

PERHAPS you, too, are like this prominent eastern manufacturer and want to know just exactly what the Bishop system is doing in other plants, other industries, and what Bishop users say about it.

When this Pennsylvania manufacturer asked me for this information I immediately pointed out to him the fact that every sales argument and every advertisement of the Bishop Calculating Recorder Company is based solely on what Bishop is doing in actual day in and day out usage in many industries.

For example, here's what one Bishop user says about how the workmen regard the Bishop system.

"Our workingmen are absolutely in accord with this recorder because it gives them a fair deal as to the number of hours they spend on each and every operation due them in connection with piece work."

Another says,

"Your system takes the matter of memory entirely out of the problem and makes it machine work in both office and shop."

Bishop adds thousands of dollars of profit to this user, he writes,

"There is only one thing that I regret and that is that we did not put in your system originally as I am sure that we would have been able to add thousands of dollars to our profit by so doing."

A box manufacturer writes,

"We can tell at a glance without any extra work just exactly what it costs to make each particular box."

It is this complete satisfaction of Bishop users which accounts for the consistent increase in the number of Bishop Systems installed yearly. It is not what Bishop *may* do, but what Bishop has already done and *is* doing in daily operation that sells the Bishop System.

The Bishop is so flexible it will fit any plant. It will fit *your* special cost-finding needs. It will solve *your* individual cost-finding problems. Let us tell you more about what Bishop is doing in a representative list of industries.

"Simplifying Your Labor Costs"

Is a booklet dealing mainly with the cost-finding problem in general. For that reason alone it will prove of much interest to any manufacturer with a cost problem. It will also tell you about the Bishop System. Write for it.

BISHOP Calculating Recorder

Bishop Calculating Recorder Co. **Woolworth Building, New York City**

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General Electric Co., Erie, Pa.
Malleable Iron Foundry
Harris & Richards, Cons. Engineers and Architects

To-day It's the Fresh-Air Foundry

THE SMOKE and gases of a foundry can be sent straight up and out.

There can be fresh, clean air at the floor at all times.

Heat prostrations in summer, and colds due to down-drafts in winter, can be eliminated.

Production can be increased.

These results are secured by designing the roof as a

POND TRUSS
PATENTED
THE ROOF THAT VENTILATES

and filling the outlets with weatherproof Pond Continuous Sash.

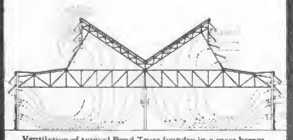
A correctly-designed Pond Truss roof ventilates in all weathers, without admitting rain to the molds. Lines of Pond Continuous Sash above the windows admit fresh air, regardless of the weather.

Size of building does not matter; the foundry above is 423 feet wide, 800 feet long. For easy control of sash in large buildings, electric motors may be used.

Lighting is as ample and uniform as ventilation.

We design every Pond Truss for its special purpose, and license its use without charge where Lupton Products are used.

A new booklet, "Air and Light in Foundries and Forge Shops," sent on request.



Ventilation of typical Pond Truss foundry in a cross breeze.

David Lupton's Sons Company
Willard & Janney Sts. Philadelphia, Pa.

Makers of modern equipment for daylighting and natural ventilation

STEEL SASH – PARTITIONS – DOORS
LUPTON
"INVESTMENT VALUE"

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Less Waste — More Haste!

War preparation industries are first on our priority list.

Many of them are already using Estes Service to perfect every operation and to send America's army into battle with greatest possible speed.

And—also—that they may enjoy, later, a peace without reaction or inefficiency.

Send For "Higher Efficiency"

An interesting book that will show you how your business can be profitable as well as patriotic. Free on request to executives only. Further specific facts especially important to you will be sent without obligation on your part if you mention which of these departments interests you most.

ESTES SERVICE
Raises the Efficiency of Factory & Office

Factory Efficiency Industrial Accounting Sales Efficiency

LV·ESTES INCORPORATED
"RAISE WAGES WHILE CUTTING COSTS"

Efficiency Engineers 1831 McCormick Bldg., Chicago

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An Austin Standard No. 3 Factory-Building for the Manufacturers of Peters Chocolate, at Fulton, N. Y.

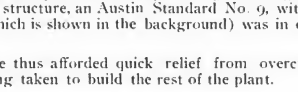
Austin Standard Factory-Buildings Offer Quick Relief From Plant Congestion

To manufacturers whose business has outgrown their plants and who are in immediate need of floor-space for quick relief, Austin Standard Factory-Buildings offer a welcome solution of their problem.

This illustration shows in the foreground an Austin Standard No. 3 Factory-Building, 80 feet by 100 feet, built for the Manufacturers of Peters Chocolate at Fulton, N. Y. It was completed and occupied in 30-working-days from date of order, while a larger structure, an Austin Standard No. 9, with a special second story (erection of which is shown in the background) was in course of construction.

The owners were thus afforded quick relief from overcrowded conditions while time was being taken to build the rest of the plant.

The nine types of Austin Standard Factory-Buildings meet most manufacturers' needs for clear-working floor-space and adaptability to machinery. Three are 30 working-day types, four 60-day types, and two multi-story types requiring somewhat longer time.



Cross-Section of an Austin Standard No. 3 Factory Building

Unit responsibility from design to delivery makes possible an Austin guarantee covering time, cost, and quality. The Austin Company also offers unexcelled service on specially designed structures and on the installation of factory equipment.

Austin Standard Factory Buildings and the facilities of the Austin Engineering, Construction, and Equipment Departments for handling special work are all described in detail in the Austin Book of Buildings, which will be sent to you on application to the nearest Austin office.

The Austin Company

Industrial Engineers and Builders

Cleveland, 16112 Euclid Ave. Eddy 4500

New York, 217 Broadway Barclay 8886

Indianapolis
Merchant's Bank Bldg. Main 6428

Detroit
Penobscot Bldg. Cherry 4460

Pittsburgh
House Bldg. Court 1993

Philadelphia
Bulletin Bldg. Spruce 1291

Washington
901 Fifteenth St. Franklin 3779

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MISSISSIPPI

A Pattern for Every Use

MOST practical and efficient form of window protection against fire and breakage. Reduces insurance and cuts cost of maintenance to a minimum. Compare *Mississippi Wire Glass* with any other manufacturer's product and be convinced of the importance of specifying outright—

MISSISSIPPI

The Pioneer Product

This Coupon Brings a Sample of FACTROLITE and Full Data

Mississippi Wire Glass Co., 219 Fifth Ave., New York
Gentlemen: Send me Catalog and "Factrolite" Paper Weight as advertised in Industrial Management. It is understood this does not obligate me in any way.
Name ....
Address ....
....
04325

Mississippi Wire Glass Company
219 Fifth Avenue, New York
Chicago, Ill. St. Louis, Mo.

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Adequate Factory Fences Prevent Disaster

THE Government asks manufacturers to conserve their resources. The first principle of conservation is protection.

At this time adequate protection of factory properties is vitally important. Shut out those who may have malicious designs on your plant by erecting an insurmountable

ANCHOR POST FENCE
OF CHAIN LINK WOVEN STEEL

Unclimbable, rustless and fire-proof it has an unequalled service record for protection and durability.

Our Catalog covers the whole subject of protective factory fences most thoroughly. May we send you a copy?

ANCHOR POST IRON WORKS
23 Cortlandt St., South, (13th Floor), New York
Philadelphia, Boston, Cleveland, Hartford, Atlant
8190-47

Anchor Post Fences

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"Hydraulic" Community Homes

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"Hydraulic" Community Homes

Labor Is Our Industrial Ammunition—Community Homes Our Warehouses

You business men know this statement to be a well-defined fact.

But what kind of Community Homes will you build?

You store munitions in fireproof fortifications. You preserve your records in safes. You even see that adequate fireproof warehouses are built for general storage. Yet you have allowed your industrial ammunition, your productive labor to live anywhere and everywhere, in tenements and shacks.

It need not cost any more to house labor comfortably.

Get the facts from our Service Department and build fireproof, permanent, sanitary homes. Add to the home environments of your labor. Add thrift to their make-up. This will naturally increase efficiency, increase your output and help win the war.

Write for late booklet on Community Homes. You should read its human appeal.

The Hydraulic Pressed Steel Co.
Cleveland, Ohio

Manufacturers of Wall, Column, Sewer, Tunnel and House Forms

Chicago Office: Fisher Bldg. 249 Dearborn St.
New York Office: Singer Bldg., 149 Broadway
Philadelphia Office: 1034 Widener Bldg.

ALLIED

When making inquiry please mention INDUSTRIAL MANAGEMENT for March

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StueBing

LIFT TRUCKS

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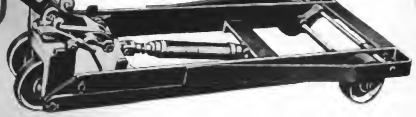

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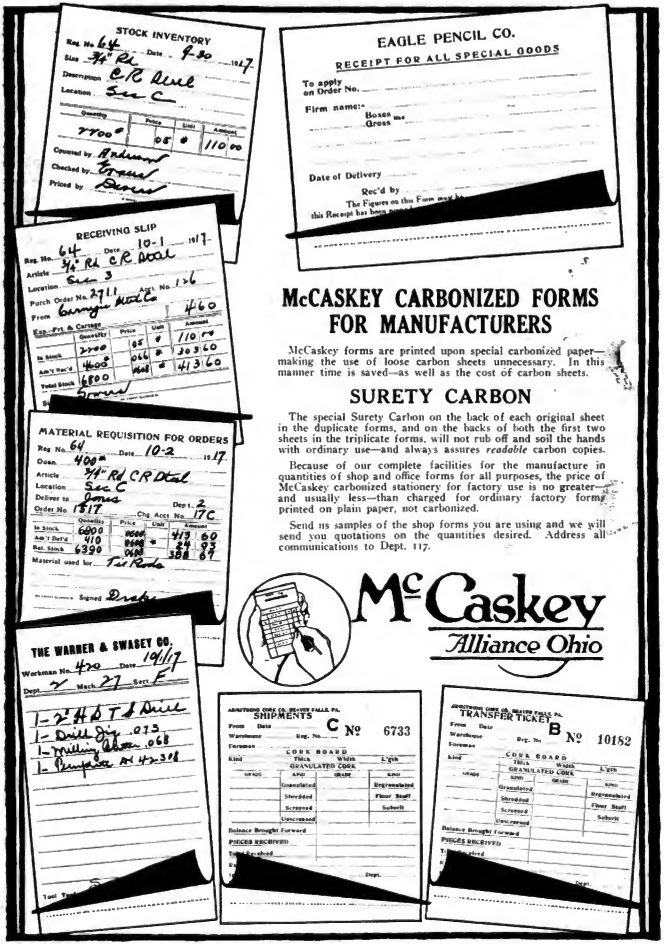

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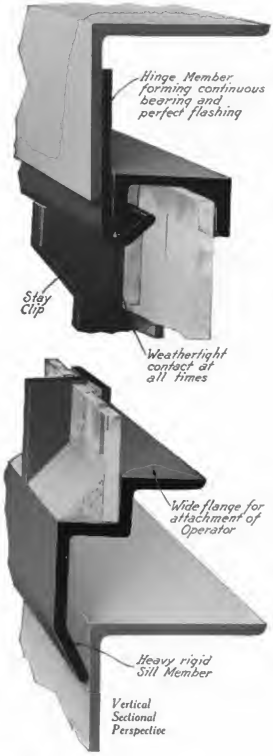

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Quite unaided or as a tool in enemy hands he is an ever present menace to your industry. He is no vague fancy. He is a reality. Read for yourself the daily news of his successes. Are you regarding him with unruffled tolerance or are you giving him the serious consideration he merits?

This alert and everwatchful enemy-servant of yours is FIRE.

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Can any sense of responsibility overestimate the menace of an enemy that can at once paralyze future production and consume the accumulated stores of past production?

The lines of defense are clean cut:

First—Prevent fire occurrence. Those trained to sense fire hazards can do much to strengthen this line. If this defense breaks down, as it may occasionally,

Second—Extinguish fire. For this, adequate equipment must be provided, in kind and proportion to the probable contingencies, all of which can be anticipated by those properly qualified. If this too fails, then

Third—Limit the extent of the fire by physical barriers so that destruction may reach only a fraction of the whole and production continue at somewhere near the normal rate. And then finally, and always, and unceasingly

Fourth—Watch! Watch thoroughly. Watch carefully. Watch intelligently. Far too often this defense is but a flimsy shell, readily penetrated from within or without by any alert or determined person. Derelicts and pensioners are not chosen for outposts; why should they suffice for watchmen? Men must be right; organization must be right; supervision must be right.

Do you want your precautions adequate for the present emergency? Do you want to meet the fire problem squarely, sanely, and backed by the best advice the country affords? Then call in the Independence Bureau.

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Story of a Remarkable Increase in Speed and Efficiency in Handling Freight at Pennsylvania Railroad Pier 4, New York City

On the unloading platform. Small lots are handled on hand trucks.

Weighing the small shipment on the automatic scales.

Dropping the shipment onto a trailer marked for the proper car.

Trailers for small-lot shipments are ranged on the outside edge of yard, backing up against unloading platform. The tractor above is shown hauling one of these into the yard. From here on the trailer is handled as in three lower opposite pictures.

In the old hand-trucking days of handling freight at Pier 4, loading 25 cars was a day's work for 165 men. Now, by improved methods and mechanical means, 40 cars are loaded by 100 men in the same time.

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The principal factors in this big saving are the storage battery tractors. These "switch engines of the freight house," used in connection with a proper layout of platforms, ramps, and yards, ensure a highly efficient handling of freight.

The pictures show the various steps in handling freight at Pier 4. At the right is shown the handling of large shipments and car lots, at the left small-lot shipments.

Notice that all freight is always on wheels. There is no piling, no congestion. The trucking situation is greatly improved by rapid unloading and handling. And every night the freight is all in the cars, the freight-house is empty—swept clear of all freight by the speedy, powerful, Edison-equipped storage battery tractors.

We have published an article describing this installation, also an interesting book showing largely by pictures the great possibilities and many uses of storage battery trucks and tractors. Ask for Pier 4 Article and Bulletin No. 600L.

Unloading platform, where large lots are loaded direct from wagon onto trailer.

Storage Battery tractor hauling trailer onto the automatic scales.

Then down the ramp into the yard in the centre of the freight house.

In this yard trains are made up for distribution to cars on the car floats.

Tractor hauling train from the yard out onto the car float.

Tractor coming back from car float into yard with string of empties.

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For instance, our junior engineers will, if necessary, actually operate machines or perform the manual operations to demonstrate the accuracy of tasks set as a result of their time studies. No "speeding up" of labor is advised. Our methods result in better earnings for you, better pay for employees, and a spirit of satisfaction in the plant which greatly increases the average length of your employees' service.

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THE ENGINEERING MAGAZINE
WRITTEN FOR INDUSTRIAL EXECUTIVES AND MECHANICAL ENGINEERS
DEVOTED TO LABOR-SAVING MACHINERY AND LABOR-SAVING MANAGEMENT
Vol. LV. March, 1918 No. 3

War Protection for Industrial Plants

Duties of Owners and Employers in Protecting American Factories Against Sabotage and Disloyal Propaganda

By Hon. Thomas W. Gregory
Attorney General of the United States

American manufacturers have a more serious responsibility today for the protection of their plants than ever before. The chief dangers are those developing from within, not those coming from without. To aid the nation and our fighting forces industrial damage must be prevented; imposing a penalty on the guilty after a plant has been destroyed does not further our prosecution of the war.

Hon. Thomas Watt Gregory *was educated at the South-Western Presbyterian University, Clarksville, Tennessee, and admitted to the Texas bar in 1885. The legal firm of which he was the principal member was employed by the State of Texas as special counsel in various suits for violating anti-trust laws during the period 1908 to 1913; during 1913 he was special assistant to the Attorney General of the United States in charge of the investigation and prosecution of officials of the New York, New Haven and Hartford Railroad Company. Since August 29, 1914, he has been Attorney General of the United States in the Cabinet of President Wilson. His department has the responsibility for prosecuting cases involving sabotage and disloyalty.*

THE people of the United States have pledged themselves to see this war through to the last dollar and to the last man. Before us lies an untold sacrifice of blood and treasure, much sorrow and heart-rending disaster, but the road is plain and leads to but one result.

This high pledge of everything that we have imposes upon manufacturers a more serious responsibility for the conserving and protection of their plants than has ever before been known. In reality, the war has made every manufacturer a partner of the soldier and sailor. Prior to the war damage to a plant or producing equipment was a private matter. If loss occurred the owner looked to the insurance companies for a large measure of recompense. Now that we are at war damage to plants has ceased to be a private matter. It is one in which the people as a whole are deeply interested. So far as the public interests are concerned, and so far as the welfare of our military forces are involved, no amount of money paid to a manufacturer can repair the loss of destroyed means of production. At the present time, perhaps as never before, *time* is the essence for success in our struggle for the preservation of our country and its national life. Every improvement in manufacturing processes, every advance in the means for reaching a military decision, every hour gained in speeding up production, shortens the war and saves American lives. In sharp contrast every loss and curtailment in production by damage done to manufacturing plants means lost time—delay—for which no amount of money can ever make up; and delay means inadequate military equipment, and inadequate military equipment for our army and navy means the loss of precious human life.

The Purpose to Injure the United States

We know the temper and unbridled brutality of our enemy. While we were neutral, struggling to keep free from the conflict, diplomatic and consular representatives of the German government in this country endeavored to wreck factories and railroads, attempted to debauch our officials and people, planned to embroil us in war with our neighbors and even tried to foment rebellion among our own citizens.

The purpose from which those acts came is still seeking internal injury to the United States

However, it is unwise to attribute every large fire in industrial plants, or among stores of manufactured materials, or along our waterfronts to the act of enemy agents, although it is very natural to suspect their activities. A recent case is the large fire at Newark, New Jersey, which was alleged to have been caused by our enemies, although an investigation by the government

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established the fact that it had other origin. But industrial loss through carelessness is as serious in its delaying effects as if the damage were caused by German spies.

Much less has been said and written of the danger from disloyal propaganda than concerning sabotage. It is sufficient to say here that the former is a most serious menace, much more so than manufacturers appreciate, and that the Department of Justice has been taking active and effective steps in its suppression.

Manufacturers Must Protect Themselves

Statistics show that the chief dangers menacing private manufacturing plants are those which orginate or are developed within their own boundaries. The real protection needed is protection within the plant itself. And the prime responsibility for the internal protection of workshops and factories rests, as it always has rested before, upon the owners and managers.

The executives who are operating a plant have the best opportunity of knowing what persons are entitled to access to their premises, and of identifying those who are to be admitted. They likewise have the best opportunity of knowing the need of fire protection as well as for sufficient watchmen. Primarily it is their duty and not that of the central government at Washington to see that their plants increase the fire protection facilities, to feel out the sentiments of their employees, to take all possible precautions to prevent the spread of disloyal propaganda and to prevent possible injury to buildings and equipment. It should be their aim, as it is the aim of the government, to prevent damage rather than wait until damage is done and then impose penalties for losses that cannot be repaired.

The Department of Justice frequently receives requests from plants asking that military guards be furnished by the government. The War Department receives a much larger number of similar requests from manufacturers who apparently take the position that inasmuch as they are producing war material they are entitled to have their plants protected by an armed guard furnished by the United States. In most cases this is an entirely wrong point of view. The establishment of a military guard will not protect the plant against carelessness or malicious damage from within which have caused most of the loss in industrial plants since the beginning of the war. For example, the existence of a military guard in some cases has created a false sense of security instead of intensifying watchfulness in the plants. There are many spots, particularly at the seaports, where the collection of a large mass of war material practically constitutes the establishment of an army base. For the protection of these large stores of supplies the government has created protected areas which, by direction of the President, are receiving military protection in the form of an armed patrol furnished by the War Department, or supplied by the State authorities acting in coöperation with the War Department. In view of the particular character of the industry, certain shipbuilding plants are likewise receiving military protection. But that military protection should not be asked of the government outside of the lines laid out above.

Munition Manufacturers Have Responsibilities of Government Agents

No government has, or can have, either the manpower, the physical means or the administrative machinery in a war of the present magnitude for supplying the precautionary methods needed in and about the innumerable plants manufacturing war materials and supplies. Owners or managers engaged in the manufacture, storage or transportation of war material should recognize the fact that they have had imposed upon them what amounts to the responsibility of government agents. They should frankly realize this and assume the attitude of providing in their plants extraordinary precautions. They have the right to ask ample police protection from local authorities, but that alone will not safeguard the interests involved. They have the right to call upon the government for all possible aid in ferreting out the sources of danger, but they have no right to ask the government to assume the responsibility for the work of internal police administration within their premises.

It is gratifying to be able to state that it has been the constant experience of the Department of Justice, and other departments of the government, that the great majority of plant owners have been quick to recognize the situation and act accordingly. But, on the other hand, there are many manufacturers who fail to take this view of the situation, vital though it is.

Violation of Industrial Rules

By Chesla C. Sherlock

Attorney at Law

COMPENSATION is denied under the workmen's Compensation Act if the injury is the result of the "serious and wilful misconduct" of the employee. The question of whether a violation of rules laid down by the employer amounts to such serious and wilful misconduct as to defeat recovery of compensation, is of great interest to employers.

The mere fact that an employee has disobeyed an express order of his employer is not sufficient to prevent him receiving compensation for any injury which he might have suffered. To permit this construction on the statute would be to return to the old days of chaos prior to the enactment of the compensation acts.

Inasmuch as the majority of the compensation acts do not expressly treat of this subject, it is evident that if the employee is not to receive compensation it must be denied him on the ground that his violation of the rules amounted to serious and wilful misconduct. Employers can readily appreciate the task that is before the courts in each case because of this necessity. Because of the situation mentioned, it is necessary for each case to stand on the circumstances peculiar to itself.

The English Attitude

The English courts in speaking of the English act, which is the parent of our laws on the subject, said in so many words that a violation of rules is not serious and wilful misconduct. Our own California court has said that a violation of each and every rule which the employer has formulated for the protection of his employees is not, in itself, serious and wilful misconduct.

It is not, however, possible for us to stop here. It is very probable and, indeed, extremely likely that in a majority of cases where the employee violates rules he is guilty of serious misconduct.

Such a violation of rules must have been wilful. This, of course, implies that the employee had knowledge of the existence of such rule; that he deliberately and with premeditation set himself in opposition to the authority of his superiors. The courts have hastened to say, however, that where a workman wilfully violates his employer's rules, but with the intention at the time of furthering the employer's interests, such a violation

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will not amount to a serious and wilful misconduct so as to defeat a recovery of compensation.

The courts have drawn a sharp distinction, from the employer's standpoint, in regard to the violation of rules, which should be kept in mind. They have said that where the employer strictly enforces all rules and does so at all times, that a disobedience of them by an employee will, other considerations being equal, amount to wilful misconduct. On the other hand, they have also said that where the employer is lax in enforcing his rules, or does so only in a dilatory or nominal manner, a violation of them will not amount to wilful misconduct on the part of the employee.

A California Case

In a California case it was said that a definition of "wilful misconduct" applicable to all cases cannot be formulated. "It may be stated in a general way that the wilful violation of a rule or order made for the employee's own safety, or the safety of others, and made by a power having authority to make such rule or order, and enforced with diligence will constitute wilful misconduct. There must be a rule or order, as distinguished from a warning. It must have been diligently enforced. It must appear that the employee is refractory, or intentionally or premeditatedly disobedient, in order to constitute wilfulness."

It is unquestionably the opinion of the courts that if an employee violates a rule made for his own safety or protection from serious bodily harm, he is guilty of misconduct; if the violation is deliberate and premeditated, then the violation amounts to wilful misconduct. It would not be consistent with the purposes of the compensation acts to allow a workman, who was acquainted with all the dangers surrounding a violation of a rule formulated for his own protection, to recover compensation for injuries received because of his own disobedient act. This would be too close to an allowance of compensation for self-inflicted injuries, which is expressly forbidden by the compensation acts themselves.

Violation of Safety Rules

It is a general rule that a violation of safety rules laid down for the protection of employees engaged in hazardous occupations, is wilful misconduct. If there is no rule, an act by an employee which imperils his own safety is not wilful misconduct, unless it amounts to foolhardiness or dare-devilry.

A failure of an electric lineman to wear a safety belt and rubber gloves, when such are required by his employer's rules, is a serious and wilful misconduct such as to defeat recovery for injuries received because of such violation.

The question of disobedience of orders involves slightly different construction on the part of the courts. While they seem to be reasonably clear in their interpretation of a violation of a fixed, known and positive rule, they are not so well settled in their opinions as to the effect of a disobedience of a direct command or order.

Some courts have, apparently without any reason, other than a desire to see a widow compensated, awarded compensation where a workman had violated an order, which, if given in the form of a rule, would have prevented him or his dependents receiving any compensation at all.

A Massachusetts Case

In a Massachusetts case, a workman was employed to do some painting near machinery in motion. He was given express orders not to attempt painting behind such machinery until at the noon hour when it would be stopped. The workman commenced to paint behind the machinery, however, within five minutes after receiving such order, was caught in the machine and killed. The Arbitration Committee awarded compensation. It is very clear that if such instructions had been given in the form of a rule, that this employee would have gone without compensation, as his disobedience was beyond doubt deliberate and wilful.

Lord Trayner, in speaking of a disobedience of orders, has more nearly expressed the universal opinion, when he said: "I cannot figure anything more serious or wilful than positive and intentional disobedience to a strict and positive order."

Where the employer has been lax and permitted a violation of rules or orders in the past, it is not wilful misconduct for an employee to violate them in the present instance. The courts impose no uncertain obligation on employers in this respect. Where one employs labor in hazardous occupations, he is duty bound to offer a workman instructions as to his own protection and to formulate rules for the workman's guidance. If the employer has not done this, or has not enforced those rules given, then he cannot defend on the ground of the employee's misconduct.

Obligation to Post Rules

The further obligation is placed on employers to properly post such rules or see that they are brought to the attention of the workmen. Said the Lord President in an English case: "I think it goes without saying that a rule not properly posted is really no rule at all; it is merely a piece of paper in the employer's pocket, so to speak, and no question of breach can arise until the rule is posted."

In the final analysis, this question of the violation of rules is purely one of fact. To say that the mere violation of a rule, in itself, was sufficient to deny compensation would controvert the whole theory of the law. Said Lord Loreburn: "In my opinion it is not the province of the court to lay down that a breach of a rule is *prima facie* evidence of serious and wilful misconduct. That is a question purely of fact, to be determined by the arbitrator as such."

Engineers in Goverment Service

ENGINEERING Council, through its American Engineering Service Committee, has during the past few months supplied to various Government departments and bureaus in response to their requests, several thousand names of engineers from which were to be selected to fill a great variety of positions in uniformed and civilian service for Army and Navy and other branches of the Government's activities in connection with the war, as well as for indirect service for manufacturers and contractors engaged upon Government war work.

To meet these demands the American Engineering Service Committee has assembled in its offices in the Engineering Societies Building, New York, extensive lists and much detailed information concerning engineers in all branches of the profession throughout the length and breadth of land.

Engineers reading these lines, to whom this request applies, are urged to send at once their names, present addresses and occupations in the Government service, with brief statement as to whether or not they are available for other service, to American Engineering Service Committee, Room 901, 29 West 39th Street, New York. Other readers are asked to bring this request to the attention of such engineers or to send information directly to the committee.

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Operation Diagrams for the Executive

How the Manufacturer of War Material Can Visualize Processes

By Adalbert R. DeKuzelewski

Shop executives who do not handle the tools of production, but who are responsible for keeping everything moving, often need to refer to the general plans of production operations, manufacturing machines, tools and gages. This article gives a method of concentrating all this information an compact operation diagrams. The example illustrated is a cylinder of a Russion automobile engine.

Mr. Adalbert R. DeKuzelewski was born in Poland and received his professional education as a mechanical engineer in the Polytechnicum in Zurich, Switzerland. Coming to the United States a few years later, he has since held the positions of tool room foremon and tool designer with the De La Vergne Machine Company, tool designer with the Northway Motors & Manufacturing Company, and master mechanic with the R. K. LeBlond Machine Tool Company. For the last two years he has been chief engineer in the New York office of the Russo-Baltic Car Works Company, a Russian machinery building firm.

WHILE the busy executive as a rule is not supposed to look into the details of manufacturing, and the main problem confronting him is the selection of competent assistants to take care of this end of the business in an efficient way, nevertheless, in order to see whether every department is being run properly, it is necessary for him every once in a while to have the means to analyze the most minute details of the shop without wasting too much of his valuable time. Besides, the important task of keeping the different departments well balanced in regard to each other—that is, to avoid shop conditions due to which, for instance, the screw-machine department would work double shift while there would be a number of milling machines standing idle—can only be done successfully by the man in full charge. To do this requires ways and means of having a picture, a description of shop details ready within reach of his hand, to get hold of the necessary data immediately and be able to give orders which can be carried out and bring results.

To achieve this end, the executive, whether he is the president, the works manager, the shop superintendent or the chief engineer, must have the data in such shape that every detail can be understood at a glance and located in a few seconds without going into an elaborate system of filing cabinets, card indexes, loose leaf binders or the like. Having all this in view, we have devised a special system of machine-shop operation diagrams which will be explained below. This system has been carried out with excellent results at the offices and shops of the Russo-Baltic Car Works Company, a large Russian concern manufacturing military automobiles and 16-passenger aeroplanes, having an office in New York City where the purchasing of machines and designing of special equipment is being done.

The Cylinder Drawings

After all necessary operations to be performed on a given part—for example let us take the standard cylinder for the automobile engine—were determined upon, all the jigs, fixtures and appliances and small tools designed, laid out and made in the shops, every single operation was drawn up separately on a sheet about 12 x 18 inches in size supplied with necessary margins to allow for loose leaf perforation. These drawings have no dimensions, but show explicitly the way the cylinder is placed in the fixture or the jig, the way of locating and clamping, the way the fixture is fastened on the machine, and show a picture of the entire manufacturing problem and all the appliances used.

Six sheets (four reproduced herewith) take all twenty-three operations (see Table I) necessary to get the cylinder machined ready for assembling, except such simple processes as sand blasting or cleaning, where no special equipment is required. They show, in a clear way, the idea of each jig, the kind and number of tools which go with it in a way to be understood by anyone who has a general idea of machine-shop work, but without being a trained expert in shop methods.

Now to go on with the story: Each operation diagram drawing was made on a sheet of standard size transparent paper. The piece being machined was drawn up with red ink, while the jig, fixture or tool was drawn with black pencil. This work completed, a blueprint was made of each, and all the blueprints perforated and bound together into a large book for the superintendent,

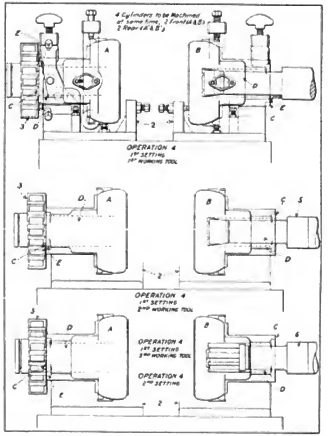

FIG. 1.—SET-UPS FOR OPERATION 4 ON AUTOMOBILE CYLINDER

Operation 4. 1st setting, 1st working tool:
Face C of cylinders A and A'.
Rough bore D of cylinders B and B'.
Chamfer E of cylinders B and B'.

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OPERATION 4. 1st setting, 2nd working tool:
Face C of cylinders A and A'.
Finish bore D of cylinders B and B'.

OPERATION 4. 1st setting, 3rd working tool:
Face C and cylinder A and A'.
Ream D of cylinder B and B'.

OPERATION 4. 2nd setting, revolve 180 degrees and face C of cylinder B and B':
Rough bore D of cylinder A and A'.
Chamber E of cylinder A and A'.
Finish bore D of cylinder A and A'.
Ream D of cylinder A and A'.

master mechanic and tool designer,—let us generalize—for our factory office.

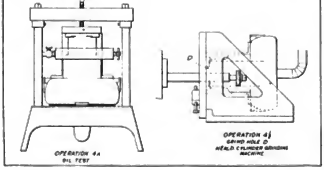

FIG. 2.—SET-UPS FOR OPERATIONS 4A AND 4½ ON AUTOMOBILE CYLINDER

Next a reduced size photoprint of each drawing was made also, a photoprint just the size of a letterhead. By this time every operation sheet was already typewritten on the same size of white sheet. To each operation sheet was attached the corresponding diagram and all bound into a ring binder 8 x 11 inches in size and placed on the desk of the busy executive.

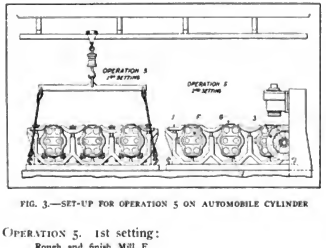

FIG. 3.—SET-UP FOR OPERATION 5 ON AUTOMOBILE CYLINDER

OPERATION 5. 1st setting:
Rough and finish Mill F.
Rough Mill G
Rough Mill H.

OPERATION 5. 2nd setting:
Rough Mill I.
Rough Mill J.

TABLE I. SCHEDULE OF OPERATIONS, MACHINES, TOOLS AND GAGES FOR AUTOMOBILE CYLINDER

1. Clean casting; sand blast.
2. Snag casting; machine, floor grinder.
Hourly production per machine, 30.
3. Inspect for blow holes and defects in casting; bench.
4. Bore, chamfer and ream two cylinder bores and face mill base of casting; 1st bore 103.5, 2nd bore 104.0, 3rd ream 104.7 mm. (0.3 mm. allowed for grinding). Note. If cylinders are not ground, hole must be reamed to 105.00 — 0.0125 mm., 2nd bore to 104.5; machine, Beaman & Smith Locomobile milling and boring machine; tools, four special fixtures, boring bars, adjustable reamers, face milling cutters; gages, Plug, 103.5 — 103.65, plug; 104.5 — 104.60, plug; 105.0 + 0.0125.
Hourly production per machine, 6.

4A. Grind cylinders (if desired); machine, Heald cylinder grinding machine; tools, special fixture; gages, as above.
Hourly production per machine, 1.

5. Mill top (right and left) manifold pads and valve pocket cover surfaces (single cut); machine, Beaman & Smith continuous milling machine; tools, four special fixtures each holding three castings, special cutters; gages, valve pocket depth gage for width on fixture.
Hourly production per machine, 20.

6. Mill fan bracket pad; machine, No. 2½ LeBlond milling machine; tools, plate fixture, face mill; gages, on fixture.
Hourly production per machine, 20.

7. Mill water pipe pad; machine, No. 2½ LeBlond milling machine; tools, plate fixture, face mill; gages, on fixture.
Hourly production per machine, 20.

8. Drill six bolt holes in bottom of cylinder flange; machine, Natco No. 30; tools, trunnion jig to take operations 8, 9, 10, 11.
Hourly production per machine, 20.

9. Drill manifold and pump pad and valve cover pad on one side of cylinder; machine, No. 14, Natco multiple spindle drilling machine; tools, same jig.
Hourly production per machine, 20.

10. Drill manifold and valve cover pad on other side of cylinder; machine, four-foot Carlton radial drill; tools, same jig, Magic chucks.
Hourly production per machine, 15.

11. Drill fan bracket pad in front of cylinder; machine, four-foot Carlton radial drill; tools, same jig, Magic chucks.
Hourly production per machine, 20.

12. Machine four valve holes (except thread), leave stock on seat for hand reaming after valve stem bushing is in place; machine, 17D Moline 6-spindle drilling machine; tools, special jig (on rails), special counterbores, special valve tools, special boring bars, grinding gages; gages, special gages for depth, plugs for size. (Tools should be made in duplicate.)
Hourly production per machine, 6.

13. Drill, tap and counterbore two cored holes in each end of cylinder; machine, Colburn drilling machine; tools, drill jig, special counterbores 80 mm. in diameter, tap, counterbore; gages, depth gage, thread gages.
Hourly production per machine, 10.

14. Tap valve plug holes; machine, Colburn drilling machine; tools, no jig, collapsing tap, chasers; gages, thread.
Hourly production per machine, 15.

15. Test under water pressure for leaks in jacket; tools, special fixture for testing at 60 pounds.
Hourly production per machine, 10.

16. Force in valve stem bushings; machine, arbor press.
Hourly production per machine, 30.

17. Ream valve stem holes (if necessary); bench; tools, special tool for reaming; gages, plug.
Hourly production per machine, 15.

18. Finish face valve seat; machine, Taylor & Fenn drilling machine; tools, piloted facing tool index fixture; gages, gage for angle and concentricity.
Hourly production per machine, 15.

19. Tap all small holes; machine, Taylor & Fenn sensitive radial drilling machine; tools, no fixture, taps; thread gages.
Hourly production per machine, 10.

20. Grind valves in place; machine, Foote-Burt valve grinder; tools; plate fixture, lapping compound; gage, prussian blue.
Hourly production per machine, 6.

21. Inspect valve seating; bench; gages, indicating prussian blue.
Hourly production per machine, 15.

22. Assemble valves, springs and collars; bench; tools, valve lifters.
Hourly production per machine, 20.

23. Final inspection; bench; all gages.

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After manufacturing is started and first lot of parts are completed, the time each operation takes is entered on each picture. It will then take only a few pages at the end of the book, and a few hours time of one of the clerks, to tabulate how many hours of each type of machines it takes to get out a lot of 100 parts.

Advantages and Savings

Everybody will realize how much time the executive can save by having all this wealth of information in the shape of a compact book on his desk. But the busy executive is not alone at the factory—he has his assistants. The works manager will find the description of each operation of service just at the moment when he is selecting additional equipment; he may be able to make up his mind without calling in a master mechanic or foreman, without analyzing drawings in the tool-drafting department, without following up all operations on—let us say—the connecting rod which happens to be made in four different departments. The master mechanic who is just about inventing a new scheme and wants to know if it is really simpler and cheaper than the old one can refer to the book. The superintendent who has just received a report that the turret lathe department holds up production by being constantly overloaded, and who contemplates having some of the work thrown into the drill press department can see what to shift by looking into the book. The chief tool designer who wants to tell a man engaged last night to use the milling scheme he has used on last year's model universal joint cage tells him to get the book. And so on including the director of the night school for apprentices. (We will need tool designers and foremen ten years from now just as much as presently.)

Drawings Need Not Be Expensive

While the objection can be raised relative to the cost of these drafting diagrams, it may be added that the work in question for a draftsman who has been in a drafting room where this has been done would be an easy task. After he gets broken in, gets to understand the idea, leaves out the unnecessary and concentrates on the essential, the work proceeds rapidly.

These drawings do not have to be scaled. A good deal of assistance can be given by having standard elements like milling machine tables or lathe turrets once made to scale on cloth, and then retraced on each diagram—but these details can be left to the chief draftsman.

There is no question but that where big quantities of work go through the shops, like the case mentioned, the system described is of great practical value. So long as it shows the operations and in legible form the entire picture of the shop processes and methods, it will pay for itself within a few weeks in saving the time of the highest priced men. Its educational value for the future is an asset acquired entirely free of charge.

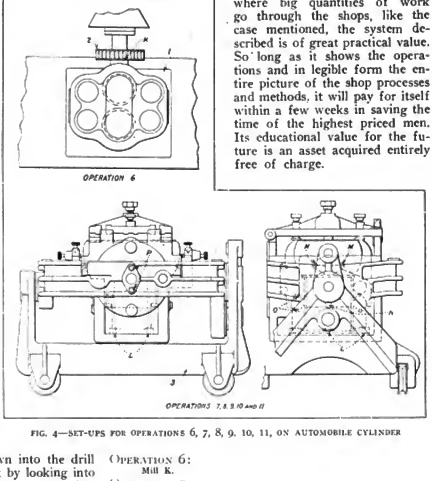

FIG. 4—SET-UPS FOR OPERATIONS 6, 7, 8, 9, 10, 11, ON AUTOMOBILE CYLINDER

Operation 6:
Mill K.

Operation 7:
Drill L, 6 holes.

Operation 8:
Drill M, Drill N, Drill O } On one side of cylinder.

Operation 9:
Drill M, Drill N } On second side of cylinder.

Operation 8:
Drill M, Drill N, Drill O } On one side of cylinder.

Operation 10:
Drill M, Drill N } On second side of cylinder.

Operation 11:
Drill P.

It may be added that in case of contracts for different parts of one machine, which are sometimes given out due to crowded shop conditions, a method of illustration as described above will certainly help everybody concerned.

Help Solve The Transportation Problem

In Connection With the Railroads

1. Cooperate and put it over. Do not kick at changes.
2. Load and unload promptly. Do not wait for a convenient season.
3. Load to capacity.
4. Do not reconsign en route. Decide the destination before the goods leave.
5. Pack securely and mark plainly.

For the Waterways

1. The construction of barges and small tow boats to provide for the adequate use of existing highways.
2. Provision for putting into shape existing waterways that have been allowed to become obsolete.
3. Provision for the wise extension of these waterways to correlate with the railroad system.

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Chemistry and Industrial Management

By Ellwood Hendrick

To check wastes of materials in industry we must buy only what we can use, use it intelligently and reclaim all possible by-products from the scrap. The author points out that chemical reactions enter into all manufacturing to a greater or less degree, and makes a plea for chemical control including the purchase of all materials on specification and the check of everything received.

Mr. Ellwood Hendrick received his professional education under Victor Meyer, and Merz and Weith at the University of Zurich, Switzerland. From 1881 to 1884 he was manager of the Albany Aniline and Chemical Works, and later was in chemical manufacturing for himself. At present he is a member of the staff of Arthur D. Little, Inc. He is a writer on chemical subjects and is the author of "Everyman's Chemistry."

EVERY time a shovelfull of coal is thrown into the fire-box of a boiler, a whole series of chemical reactions take place. When metal is melted in a cupola all sorts of things happen; in fact there are very lively goings on within the domain of chemistry or of physics every time a piece of metal is heated. Painting is a chemical process, and a very complex one, too, and so is nearly everything that happens in a tank or a tub.

We can't get away from chemistry in industry; the most we can do is to shut our eyes to it and that is not always profitable. It has to do with the administration of materials. The eye of the master, according to Benjamin Franklin, is an invaluable asset, but its blind spots do not count. It may observe the men, see that they are diligent and well directed, and it may see that correct practices are observed, but unless it has the vision of chemistry, it cannot see how materials behave, and these are as important in making profits as are men.

Chemical Control in Manufacturing

Chemical control does not mean having a laboratory with a man, a balance, some reagent bottles, test-tubes, beakers, caseroles, Florence flasks and the like in it. One can't even select a good young chemist unless he has chemical understanding himself. The bane of American manufacturing has been that chemistry and physics have been neglected while the administration of materials has been placed in charge of foremen who do not know molecules. Those are the fellows who put things over on the old man. A young chemist, fresh from college, can't make any headway against them because they have entrenched themselves. And the young college man isn't up to the job of chasing molecules all around through the works and finding out what they are up to, anyway. That is the chemist's task: he is a molecule chaser. Nobody can see molecules, but they are always organizing, sometimes nice and obedient, just as the master desires; and then again they could give an anarchist organizer spades and trumps in sabotage. A young fellow at twenty dollars a week, who is under instructions to stay in his laboratory and make tests, can't determine how they are behaving. Conditions in little glass bulbs are very different from those in big iron containers. Laboratory processes that are rich in yield often show marvelous divergencies when a factory charge is made. Under different relations of mass to surface and with changed conditions of temperature and pressure, the molecules form new and entirely unexpected unions and it takes more than a little experience to catch onto their ways. The chemical engineer is to materials what the lawyer is to contracts and business procedure, and he needs experience as well as schooling.

Chemical Advice in Industry

The point that I am trying to make is the need of sound, competent, chemical advice in the operation of a manufacturing concern just as good legal advice is needed in its organization and whenever, for instance, the old man loses his temper.

The last word has not been said in regard to any known chemical reaction—so there's nobody who knows it all. On the other hand, there is hardly a single industry that lacks its chemical side. Even the matters of fuel, boiler water and lubrication are neglected unless they are under chemical control, and neglect means waste. A glance at laboratory records of analyses of boiler compounds which have been bought at prices mounting up to several thousand dollars a year for single plants is enough to make a manager sick. A late one was a little molasses in water at a dollar a gallon.

Chemical control enables a manufacturer to know his product. Usually he guarantees his output and his guaranty is a liability. The knowledge that this control gives him of his product insures him against loss under his guaranty. So if it discharges a liability it is an asset. It substantiates also the manufacturer's own trademark. On the other hand it discounts the trademark premium he pays on his raw materials. In normal times a man who buys on specification usually enjoys a buyer's market; if he buys trademarked goods it is usually a seller's market.

Unintelligent Buying

A street railway company has constantly before it problems of painting, cleaning, lubrication, the purchase of metals for various purposes, requiring different qualities that are bought either on specification or by trademark and a hundred other chemical problems; these must be met, or ignored. With no reflections upon the wisdom and judgment of purchasing agents, I think the statement cannot be successfully contradicted that the one who has access to a thoroughly equipped and manned laboratory will save a great deal more for his company than the one who has not. There are corporations that have their favorite sources for supplies of all kinds and if anyone tries to demonstrate that their methods of purchase may be improved upon, they successfully make a goat of him. The old man or somebody in authority sees to it that no change is made and that they continue to buy as heretofore from old friends. Then the old friends see to it that the company gets goods at fair prices. Thus the buyer leaves everything to the seller. This may make the seller and it may not break the buyer, but it is not intelligent buying.

The other day the writer went into a well-known clothing and furnishing house in New York City to buy an overcoat. The purchase was made—and, "Yes," he needed some underwear; medium light balbriggan. The price was $2 a garment, or $4 a suit. It seemed dear. The house is of the first rank and the proprietors urge upon customers that they can get best served by buying all their wearing apparel there. But those shirts and drawers seemed dear. Two suits were bought instead of the number desired on the ground that he might do

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better somewhere else. The next day he went over to Third Avenue, where he was probably taken for a prosperous walking delegate. "All our goods iss strickelly shoonion made," said the salesman. But underwear of the same weight, staple and finish were purchased for 75 cents a garment, or $1.50 per suit. The first lot was bought on trademark, the second lot on specification. The seller does not look out for competition and the buyer does—if he is alive to his job. With chemical advice the competitive field is open; without it it is closed; you must buy what your hired man says he can use.

Savings on Odds and Ends

A retail dry-goods merchant and a chemist were having an idle chat one evening when the merchant said, in a joking way, "You chemists are getting your teeth into everything, but you can't make anything out of my business. I am immune from the chemist's attack." "You need him," said the chemist, "in the worst way. You sell drygoods and guarantee them. From the time they were made until you get them they may have changed hands three or four times and what only a textile chemist could tell you about the merchandise you sell and warrant would be illuminating and I fear occasionally it would shock you. But let us leave that out of consideration. I shall approach you on the subject of testing drygoods for you a little later when my equipment is complete. What do you say to a nice little dinner party next year to be paid for by you or me according to the outcome of what I am about to propose? Suppose you tell me that you want my establishment to look into your supply department. That means besides fuel such odds and ends as paper, stationery, soap, etc. We shall charge you our regular fee and make specifications for purchases. If you do not make savings above the cost I will pay for the dinner, and if your savings are worth while, you are to pay for it."

The merchant agreed, and paid for the dinner because his savings were several thousand dollars. There was some $600 saved on soap powder alone for washing floors. Theretofore it had been bought as package or trademark goods.

Specification and Check

Merchandise, whether fuel, supplies, raw materials or finished products, is of three kinds: Standard, special and proprietary. For standard goods tests are established. Usually the chemist is needed to check. For special goods he is needed to specify. Proprietary goods are sold under patents or in packages with labels and directions or in connection with service which shows how to use them and get the best results. The item of service in connection with proprietary articles is growing rather than decreasing, as is evident from the increasing number of engineers and chemists employed in sales departments. It is wholly legitimate, but it is a charge that must be loaded upon sales. It is of advantage to the seller because it tends to close the market to the buyer. If on the other hand, the buyer knows exactly what he wants and how to use it, and knows also of several sources of supply instead of one, and can specify so that any one of the several producers can furnish the product he wants, his economical position is improved.

Here we are in the midst of the worst war in history, with billions and billions to be paid as the least cost of it and labor almost impossible to secure, and yet we see great wastes flowing out of the spigots on every hand. If we could only utilize intelligently everything we waste we could almost pay for the war as it progresses. Of course, applied science has not got as far as that yet, but it is much further advanced than the unscientific man knows. How manufacturers can afford to get along without having competent chemical advice constantly available to them is beyond the comprehension of most chemists.

Misconceptions About Chemists

There are a number of misconceptions about chemists abroad and we might as well consider one or two of them. When a manufacturer gets into trouble about his product he does not always come to headquarters by any means. He waits and waits and tries this and that and finally, when he comes to the conclusion that there is no balm in Gilead, he goes to the chemist with his woes. His overhead charges are a thousand dollars a day, his wares will not sell because something about them is wrong, and "What is the matter with the goods? Answer immediately," is his demand. Now the trouble lies in the way the molecules have been behaving and it may take months to find out.

If he had had the habit to take his troubles where troubles belong, to his chemical advisor, he would have had somebody working on the problem from the time the difficulty first showed itself, and by the time he sent his nervous telegram, the problem might have been solved. There's no use in trying to hurry such things: if one loses his pocketbook he does not set a date by which it must be found; he's thankful to get it at any time. The chemist's task in discovering what is wrong is often much harder than finding a lost pocketbook. Sometimes he gets it and sometimes he doesn't. In problems of research like this what he needs most is time. Tests go through a well managed laboratory in short order, but research will not be hurried.

Another idea that is unfortunately current is that a chemist can analyze anything. Now he can indeed analyze anything, but his analysis will not always tell what the thing analyzed is or how it is made. Chemistry isn't a finshed science by any manner of means. There is a vast amount that isn't known yet and the chemist has to feel his way along, just as the business man has to feel his way along in establishing credit. His problems with materials are almost as individual as the business man's problems with men. But the chemist is the only one who can actually discover what is happening to materials as they pass through the works on their way to become saleable goods.

The business man who takes his problems to the chemist will be surprised to find how wide their chemical side is. He is likely to be surprised at a great deal of information that will develop. But if he wants to be ahead of the game he must invite chemistry into his business and keep it there. The way to do that is to get a sense of the chemical aspect of his works before the day of trouble comes.

Definition of Engineering Council

Adopted February 21, 1018

Engineering Council is an organization of national technical societies of America created to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be made possible. Engineering Council is now composed of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, having a membership of 33,000 and known as the Founder Societies.

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Mastering Power Production III.

Materials Can Only Be Mastered By Knowing All the Facts

By Walter N. Polakov

Following the declaration of the principle that exact knowledge must be possessed before materials can be properly selected the author states, "In case of materials entering into a process of power production, the cost of the materials has little or no bearing on the cost of the finished product." The example used to illustrate these principles is coal. Under the headings of "Care of Materials" and "Care of Equipment" methods for planning and caring for all the materials and supplies of the power plant are fully outlined. Emphasis is laid on the importance of fitting both materials and equipment for the service to be performed.

Mr. Walter N. Polakov is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven and Hartford Railroad Company.

GREAT historical events reflect the state of mind of contemporary people. Moreover, it is the economic structure of society or the mode of production that, in the final count, determines the ideals. The world war which commenced as a clash between efficiently organized production on one side and antiquated financial control of markets on the other, gradually took the form of a crusade for liberation from imperialistic oppression or, stated in more definite terms, for the abolition of autocratic power and arbitrary use of special privileges.

To win a war, whether international or industrial, one must master materials better than his opponent. To accomplish this task, it is necessary to eliminate all guess, uncertainty, favoritism and waste; a definite predetermined, impartial and efficient use of materials is a *conditio sine qua non* of success.

So long, however, as our industries and public utilities are controlled by men whose vision is limited in a narrow circle of private gains, small wonder that the representatives of the people extend over them governmental control. The feeling of distrust spreads toward managerial methods based upon obsolete ideals and fostered by the conditions of the past, and the right to mismanage socially necessary production and transportation, or to waste the nation's natural resources, is being gradually taken away.

Prices *versus* Value of Materials

The most conspicuous of this harmful inheritance from the age of mercantile capital is the habit of judging the value of services and of goods alike from their market price. Men, who are traders by profession and speculators by temperament, are accustomed to accumulate wealth by buying cheap goods and reselling them for what the traffic will stand. The process is thus to transform money into commodity and exchange it later for a larger sum of money. Buying certain materials needed in the process of power production is made with an intention to realize larger returns when the raw material reappears in the new form of a marketable commodity—energy. As a mere bookkeeping proposition, it looks as if the lowest price paid for these materials is capable of enhancing the profit, or the difference between the cost-price and the market-value of the power.

A technically unsophisticated purchasing agent, or an official dictating the policy of a concern, is often trapped in the tenets of this fallacy. While it might be true in a case of direct reselling of merchandise, that the low purchase price leaves a larger margin for profit, *in case of materials entering into a process of power production, the cost of the materials has little or no bearing on the cost of the finished product.* In fact, this rule is practically without exceptions, provided the purchase price is commensurate with the quality of the materials.

Inasmuch as nothing but scientifically conducted experiment under service conditions, carried out by a trained engineering investigator, can establish the fact of *what article is cheapest to use, as opposed to what is cheapest to buy*, the purchasing agent should be directed only by properly established standards. To enable their timely revision, he should report to the engineers setting the standards any fluctuations in the purchase prices of all cataloged materials. It is hardly necessary to illustrate this assertion by examples only too well known to the operating engineers, but often obscure to the financial directors. A cheap grade of lubricants, anti-friction metals, boiler tubes, fittings, etc., does not only enormously increase the maintenance expense but seriously jeopardizes the safety of men and property and, above all, frequently causes interruptions in service with all its disastrous consequences.

Of all the materials used in the steam power plant the fuel (more specifically coal), for the reason that it is by far the largest item in the operating expenses attracts more attention to the problem of its selection than even the operators themselves.

Coal as an Example

The most primitive form of selecting coal is the comparison of prices per ton. This is occasionally modified by legal regulations, security of deliveries, terms of contract, and similar commercial considerations. Thus in New York City anthracite has been favored and even enforced so long as law-makers believed bituminous coal to be smoky; in Maine, Pocahontas and New River coal were in vogue, even in steel furnaces, since little ash may be hauled over the long route; in Pennsylvania, sometimes ill fitting coal is brought from far away mines because of a lower bid per ton on a long term contract.

In the first decade of this century the methods of buying bituminous coal on a heat value basis became fashionable. The more conspicuous of these methods

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were those of the United States Geological Survey, Interborough Rapid Transit, City of New York and The Celluloid Company. It was as much a step in the proper direction as the selection of food on its calorific value yet the parallel goes further. A dietician knows that foods of equal heat value have different coefficients of digestibility; moreover, there are proteins that stop animal growth while others stimulate it. Similarly, it is not half enough to know that a million B. t. u.'s cost so much and the price may be further adjusted according to the variation from the normal proximate analysis. The fitness of the coal for existing furnace, service, local conditions, etc., must be carefully investigated before it can be said whether the coal containing most B. t. u.'s for a penny is the cheapest to use or not.

The greatest unquestionable merit of this method of payment for coal lies in the fact that *it calls for exact knowledge*. The knowledge of the quality of delivery on the part of the buyer stimulates the seller to exercise care in preparation of the order; eventually the knowledge of the effect of the composition of coal on the ultimate results obtained helps the user to adjust specifications to the requirements, or *vice versa* to modify the conditions of use according to the character of fuel. Neither of these adjustments could be made without a knowledge of the characteristics of the coal. Moreover, the contents, the nature of the volatile matter, peculiarities of ash, etc., must be known *before* the coal is used, since variations in the properties of coal call for different ratios of air to coal, shorter or longer periods between levelling or cleaning fires, thicknesses of fuel bed, etc., if high efficiency is to be had.

The importance of the information obtained from the coal laboratory could hardly be emphasized enough, and a modest investment for its simple equipment is perhaps the best investment after the boiler room instruments, from the viewpoint of returns. The employment of an outside laboratory, however, is warranted only in a case when the analysis returns are available before the coal is delivered in the boiler room. The knowledge of what kind of coal has been burned is no consolation if the methods of its utilization were guessed wrong.

Social Meaning of Waste

Before outlining successful methods of mastering materials it is timely to point out what is meant here by "economy," "saving," and similar expressions. While it is common to measure any kind of unprofitable use of time, material and effort—i. e., waste—in terms of money, the true social meaning of waste (as opposed to saving) is both deeper and broader than merely loss of money. Any material has a value only insofar as it is the product of labor. Coal represents labor of an endless chain of men—lumbermen, teamsters, steel-mill workers, machinists, chemists, railroad men, farmers, architects, cattle men, engineers, doctors, miners and so on, probably without a single exception *all* trades contribute in their toil, even without knowing it, to the possibility of working out mines.

From this standpoint any waste of coal, or any other material, means that a certain amount of the work of all these numberless men, whose work intricately depends one upon the other, is rendered useless. This in turn means that the time they toiled to produce something that is thrown away was not used to anybody's good. As this waste is considerable the sum total of the portions of time that all the men worked to produce something that is wasted is very large. Sometime ago, in Austria a careful study revealed the fact that if all

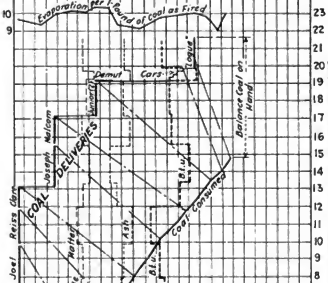

FIG. 4. COAL RECORD CHART

this waste be eliminated, as well as wasteful occupations abolished, the male population of between the ages of 16 and 50 could produce all that is regularly consumed working less than four hours per day.

To drive the point nearer home, our wastefulness and mismanagement wore out the whole industrial mechanism to the extent of requiring five days of emergency repair and ten Mondays for patching, since an economic structure that is based solely on production for private gain develops internal contradictions leading to its ultimate collapse.

Managerial Functions

Those directing the production of power, or any other commodity, cannot ignore the responsibilities coupled with their authority. Waste in any form means the ruination of the individual enterprise as well as the undermining of the prosperity of a community.

It is quite obvious that most of the losses occur in operation due to the imperfect organization, lack of knowledge and resulting poor methods, but it is equally evident that no improvement along these lines can be made until we learn how to master the materials we use. This function is decidedly managerial, inasmuch as workman, firemen, engineers, etc., are expected to use the equipment, supplies and materials *provided for them*, and if they are unsuitable for attainment of predetermined results the entire responsibility rests with those causing such handicaps. The functions may be divided into two main groups, "Care of Material" and "Care of Equipment."

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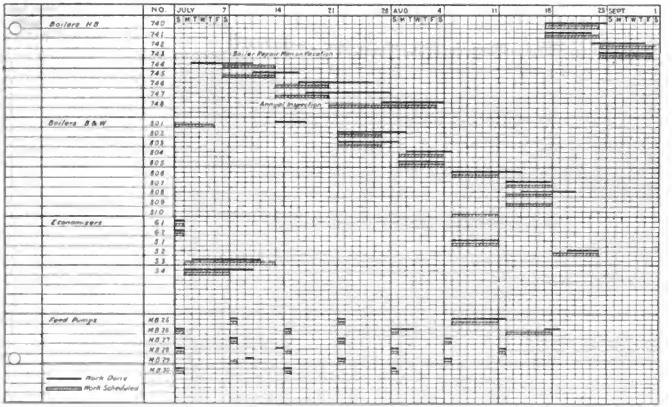

FIG. 5. MAINTENANCE RECORD OF LARGE POWER PLANT

The organization to care for materials embraces the following details:

Selecting materials.
Purchasing materials.
Testing materials.
Storing materials.

Similarly the care of equipment embraces:

Scheduling maintenance.
Specifying work.
Providing labor and material.
Instructions.
Compensation.

CARE OF MATERIALS

All materials used in connection with power production are controlled by the planning office from the time of issue of the purchase order until the articles are issued for use by the storekeeper.

To facilitate identification of stores for charges, etc., all stores are classified into five groups:

Raw material as the name indicates, is the material which is converted into product though losing its identity, such, for instance, as fuel.

Supplies are all standardized materials used in the plant, being neither converted into product nor forming parts of the equipment, such as lubricants, stationery, cleaning materials, tools and implements, etc.

Maintenance stores include all such articles as are used for maintaining the plant and equipment in perfect operating condition, as spare parts, gaskets, transformer oil, boiler compound, motor brushes, etc.

Second-hand stores. All returned parts of the equipment, etc., not needed temporarily are returned to the store and issued subsequently in preference to similar new articles. They constitute second-hand stores.

Scrap and refuse. All material that has lost its usefulness for the plant is turned over to the store to be sold or otherwise disposed of, for instance, old boiler tubes, brass parts, grates, ashes, burned out lamps, etc.

When the planning office establishes standard specification for material, the purchasing agent is notified and no other article should be substituted unless such course is unavoidable and the planning office is notified in advance so that necessary measures can be taken to minimize the ill effect of the use of that which is less suitable. Such material as needs constant testing is sampled and submitted to the laboratory for test and report prior to the use of the new delivery. Besides coal, such a procedure may be found necessary for fire brick, transformer oil, new unclassified purchases, etc.

The storekeeper is the custodian of all material in the plant. As every article represents money paid for it, the same care must be exercised over it as for cash in a safe or a bank. Receiving, storing and issuing is carefully recorded and the following seven rules rigidly observed:

1. Check every delivery as to quantity and standard of quality.
2. Have only the prescribed quantity of each article on hand.
3. Order new purchase only when amount left is equal to that designated as "order point," i. e., just enough to last until a new supply reaches the stores.
4. Issue from old stock until exhausted. Never mix new and old lots.
5. Issue only on presentation of store issue slip properly indorsed.
6. Orders, issues and permanent balance of stores shall be handled through the planning office.
7. Take care to protect stores against deterioration.

Small quantities of constantly needed stores may be kept in a sub-store and handled by the watch engineer as the storekeeper's representative in his absence.

As the most important item of material used in a power plant is coal, special problems are presented in its care. The quantity of coal to be stored is a complicated question depending on numerous local condi-

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tions which cannot be discussed here at length. Plant operation free from interruption is a chief factor; deterioration and possibility of spontaneous combustion should also be taken into account. Interest on the coal pile seldom receives due attention. All deliveries being unequal in quality and characteristic, it is undesirable to mix various coals, while again this seldom can be avoided. A chart, shown in Figure 4, is a very serviceable means of reference and control, as it shows at a glance the quantity on hand at any day, quality of each delivery or daily consumed mixture, movement of cars or barges, demurrage, daily receipts and consumption, result obtained and other useful information.

Necessity of Planning Handling of Material

The next function the management should take care concerning materials is their handling or moving. It is obvious that to execute any work requiring use of material we must know:

1. What material is needed.
2. Where it is needed.
3. When it is needed.
4. What is to be done with it.

Very often when certain work is to be done in a plant, merely a general order is given as to what is wanted. The man is left to find out for himself when the machine will be available to work on. When he starts he discovers that he needs certain materials; then he hunts for it and when he gets it he takes plenty to avoid shortage while working, and when he is through the left overs are stuck somewhere in a cupboard. The good excuse is "to have it handy next time," but as it regularly happens "next time" he can't find it. The story merely repeats: waste of time to find out what is needed, waste of more time to go and fetch it, waste of excess material. Yet no mechanic could be blamed for it as his job is merely to do the work, and not to manage the power plant.

We detail duties of such a nature to the planning office. The experience of the planning engineer aided with standards and records helps him avoid mistakes and save the time of the mechanic and the cost of the job. While the organization and functions of the planning office will be explained later on, suffice it to say in this connection that *the control of issuing, moving and using of materials is one of the duties of the planning office,* a most vital organ of a power plant.

Care of Equipment

The maintenance of equipment in first-class operating condition is another imperative task of a planning department. Proper upkeep of power equipment is of far greater influence on output and economy than it is in any other manufacturing department. Neglect to clean the heating surface of boilers, prevent numerous little leaks here and there, etc., seriously affects the cost of power. Careless, sporadic inspection of equipment is much more hazardous in power plants than anywhere else, as it may result not only in crippling one section of a plant, or even cause a shutdown, but is liable to cause more serious disaster. The old saying that a stitch in time saves nine is nowhere more

ELECTRICAL INSPECTION ROUTE CARD

MAKE THE FOLLOWING INSPECTIONS IN THE ORDER NAMED

JAN. 1 TO JULY 1, 1916.

WATCH 7-3 EVEN SUNDAYS

APPARATUS	2	16	30	13	27	12	26	9	23	7	21	4	18	
1 - 25 Cy. Gens.	✓	✓												
2 - No. 11	✓	✓												
3 - No. 13	✓	✓												
4 - No. 12	✓	✓												
5 - A	✓	✓												
6 - B	✓	✓												
7 - C	✓	✓												
8 - D	✓	✓												
9 - S	✓	✓												
10 - CS	✓	R												
11 - T	✓	✓												
12 - Coal Larry No. 3	✓	✓												
13 - " " "	✓	✓												
14 - Battery Blower	✓	✓												
15 - Economizer	✓	✓												
16 - Coal Elevator (Ry.)	✓	✓												
17 - Coal Crusher	✓	✓												
18 - Coal Conveyor	✓	✓												
20 - Ventilators	✓	O												
21 - Ash Locomotive	✓	✓												
22 - Oil Filters	✓	✓												
23 - Oil Pump	✓	✓												
24 - Control Bench	✓	✓												
25 - Feeder Board	✓	✓												
26 - Local Ser. Board	✓	✓												
27 - Exciter Board	✓	✓												
28 - Signal Board	✓	✓												
R - Repair Suggested														
O - Ordered out														
SIGNED__________________	I	P												

FIG. 6. INSPECTION ROUTE CARD

Boiler # 539 M B.

Hornsby-Bigelow WT boiler

Power Plant	[illegible]
Location	West Boiler Room
Plant No.	[illegible]
Service For	Steam
Make	Hornsby [illegible] Bigelow Boiler [illegible]
Style No.	
Type	Water tube, Vertical baffles
Serial No.	
Catalogue No.	
Date of Install	March 1911
Capacity	625 H P
Rev. Per Min.	
	6250 sq ft H S [illegible] tubes

File No. [illegible] | Drwg. No. 11521 | Alter [illegible] | Alter

REMARKS Nov 1914 top end of baffles extended to superheater result the t° of steam increased 50° F over

FIG. 7. FRONT OF EQUIPMENT RECORD CARD

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applicable than it is in the modern power plant. To secure the possibility of obtaining uniformly good results from proper methods of operation—that is, make it possible for the men to live up to their tasks and earn a bonus—the plant's equipment must be maintained in uniformly good condition. To that end, the planning department contributes by studying physical causes affecting economy and safety and determines reasonable periods at which inspections, cleanings and other similar work shall be made. Such schedules are exemplified by the chart of Figure 5 and the electrical inspection card of Figure 6.

REPAIR RECORD

Date Out	Days & Hours Out of Service	NATURE OF REPAIR	COST Labor	COST Material	Total
12/28 1914	10 Days	Cut change water inspect internally. Bracket valves cleaned, repacked #1, 2, 3 & 9 blow off valves repacked #4 replaced & repaired etc.	15.80	5.24	21.04
2/26 1915	33 days	Inspected by McGowan & M. C. Co. on 3-11-15 Main steam drum & mud drum cleaned. Tubes polished cut in 3-31-15.	24.10	1.98	26.08
6-1	12 d.	Change water, insp. tubes combustion removed Water column overhauled #3 & #7 blow down valves renewed. Drum cleaned Cut in 6-13-15	12.20	34.40	46.60
8-24	7 days	Change water, inspect tubes combustion removed Tubes expanded #1-1st row-2nd unit #1-2-3-1 row-3rd unit #1-2-2nd row-3rd unit Cut in 9-1-15	9.57	3.49	13.06
10-15	8 d	Order S-19	7.46	2.48	9.94
12-20	7 d.	Order S-19	8.34	3.05	11.39
		Annual Cost			128.11
		Idle Charge 67 days			21.40
		Total			$149.51

FIG. 8. BACK OF EQUIPMENT RECORD CARD

The by-effects of work done at regular intervals are: Reduced time the equipment is idle, reduced number of maintenance men needed, lower repair and maintenance cost, and above all, the operating men (who may be poor mechanics) are not dividing their attention between operating functions and mechanical work, but consistently live up to their tasks.

The general procedure of this work is simple. The planning department assigns at specified intervals the qualified men to make inspection routes through the plant and report all findings on a card. Necessary repairs are authorized by the issue of a work order specifying details and time when it is to be started and finished so as not to interfere with operating requirements. When the job is finished, all expenses are computed and entered on the record card, Figures 7 and 8, one covering each unit of equipment in the plant. The data on these cards are further used in the planning department to analyze what method of repair and what material produces the best results at the lowest cost, and thus leads to continual improvements.

As far as stimulation of maintenance men is concerned, they receive their bonus over and above the daily wages only for those days when no interruption in operation occurs on account of their defective maintenance, and they lose their bonus whenever it is proved that the operating men fall short of their tasks on account of poor upkeep. For instance, a firemen fails to secure the expected boiler-efficiency rating, because the gage connection is leaking and he adjusts the damper in accordance with wrong indications. This would be the instrument man's fault, not the fireman's, and while the former will lose his bonus, the latter may be allowed his, if nothing else was wrong. To carry out this plan, it is evidently the duty of the planning department to investigate every failure at once, before the man affected comes back for his next turn; otherwise, the mistake may be unknowingly repeated and a late investigation may not reveal the real cause.

The success of our maintenance method depends in no small degree upon careful selection, standardization and purchase of all supplies and materials. The maintenance record cards, Figures 7 and 8 referred to before, are of material assistance for at least abandoning the use of supplies and materials that prove short-lived and expensive. Expensiveness, however, is figured out in the planning department not as cost per pound, foot, or what not, but as cost per time. Such data often give an effective weapon to fight some short-sighted purchasing agent's hobby to buy the cheapest stuff on the market, or a general fancy that the most expensive is the best. Neither of these generalities can, of course, remain true in all cases. In this way, for instance, it may be found that a very cheap and comparatively poor quality of firebrick gave excellent results if used in conjunction with a somewhat expensive fireclay cement, or that expensive grease for cylinder lubrication was cheaper to use than the cheapest cylinder oil, etc.

To sum up, when a plant is operated on the principle of task-work-with-bonus, this method of caring for equipment becomes still more important, as *the task may be accomplished only when the equipment is in first class operating condition.* Falling short of the predetermined economic result by an operating man because of poor maintenance is not a reason to deny him his bonus; in fact its payment serves as a penalty on the management for failure to keep the plant in the best possible shape, or unwisely saving on material.

How far such neglect to take proper care of equipment sometimes goes may be well illustrated by a case of a New Jersey power house. Several years ago, the maintenance of the plant was averaging $4,000 per month. In the past years this account was reduced by almost half, with the result that not only the coal consumption per kwh. was increased in a dangerous proportion, but the capacity of dirty, neglected equipment was reduced so materially that any overhauling would necessitate curtailment of the output.

Emphasis is laid in this article on the importance of careful fitting of materials and equipment for the service: far greater importance must be attached to the men whose work consists in keeping the plant in a condition that permits the utilization of its ultimate efficiency. A successful mastering of the material side of a power plant calls for more than first-class mechanics engaged in its up-keep—it presupposes a clear comprehension by the management of its first function: *To base orders on facts.*

(To be continued)

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Handling Bulk Material by Man and Machine Power—A Comparison

By George Frederick Zimmer

This article is based on British practice and gives comparative costs of handling coal by hand labor and by machinery. By hand labor the per ton labor cost may range from one-fifth to one-half of an hour's wage; by machinery the author gives a handling cost per ton as low as 0.94 cent.

Mr. George Frederick Zimmer was associated for fifteen years following 1882 with Mr. James Harrison Carter, the well known pioneer engineer of English roller milling. In 1897 he started practice as a consulting engineer, and at the same time began to market a reciprocating steam conveyor of his own development. He is an extensive writer on the art of mechanical handling of materials and is the author of two books, "The Mechanical Handling of Material," published in 1905, and "The Mechanical Handling and Storing of Material During and After the War," published in 1917.

A MODERN plant for the mechanical handling of material, unless of very small capacity, cannot help being a commercial success, for we need only bear in mind that an expenditure of from £750 to £1,000 ($3,652 to $4,870) on machinery is justifiable, if one labor unit can thereby be dispensed with. Yet the careful investor would like fuller information in order to enable him to calculate beforehand approximately what he will save by his capital outlay. Reliable information which will give us the comparative cost of handling say a ton of coal is, however, difficult to obtain, as it depends to a great extent on specific conditions, but the following brief data will help us to form approximate estimates for a variety of propositions.

So far as hand labor is concerned we find:

1. An average man, paid at piecework rate, can shovel coal out of a railway truck at the rate of five tons per hour, either into a hopper forming the receiving terminal of a coal handling device, or into any other receptacle, provided its upper edge does not reach in height beyond the floor level of the railway truck. The actual cost of handling one ton of coal in this way would be one-fifth of the hourly wage, plus a small allowance for wear and tear on tools

2. If the coal is to be unloaded and wheeled in a barrow a distance of 100 feet, and then stacked by means of a gang plank in a heap of an average height of six feet, one man can handle 3.4 tons per hour. A coal heap of an average height of six feet must be understood as the average between 0 and 12.

3. In order to reclaim the coal from a heap by shovel and barrow, and wheel it to a point 50 to 100 yards away—say, 75 yards as an average—and empty the coal there, one man can handle two tons per hour, so that the cost of one ton thus handled will be equal to half-an-hour's wage; for every 10 yards additional distance conveyed, one-fortieth of the hourly payment must be added to this.

It is rather difficult to make reliable statements concerning general comparisons between the hand labor for discharging railway trucks, and that performed by mechanical means, particularly as these latter appliances are generally fixtures, and are therefore best adapted to serve a mechanical handling plant; a coal truck to be discharged by hand can generally be shunted into a position nearest the spot where the coal is to be used or stacked.

There are also a great variety of tips driven by either hydraulic or electric means; some raise the trucks to an angle of 45 to 50 degrees, at which they completely empty; others turn them over laterally, such as the M'Myler Tip, by an angle of 135 degrees, which will give the side of the truck, when turned over an angle of 45 degrees. Others again will turn the truck through an angle of 180 degrees, also sideways, so that it is exactly upside down. It is therefore advisable to obtain an estimate from the makers after deciding upon the type of tip and the number of trucks to be discharged per hour.

We will take, for example, an electrically driven tip for end-door trucks, which raises the truck floor to an angle of 45 to 50 degrees.

Such a tip would cost, approximately	£625	$3,043.75
Foundations	150	730.50
Connections with all necessary wirings	125	608.75
Turntable	250	1,217.50
Together	£1,150	$5,600.50

The capacity of such an installation, if for five trucks per hour, will be, annually, about 160,000 tons maximum. To work the tip one driver and one laborer are necessary. As an additional safeguard against breakdowns and for the sake of greater economy it would be better to employ two tips, and use each only for a capacity of 80,000 tons. If two tips are thus employed the turntable will not be necessary, as if they are erected right and left the end door trucks can be emptied if the door is foremost or at the rear. With such an arrangement these tips need only be at work for about 3½ hours per day, and the cost of handling, per ton, will be about three farthings (1½ cents). For current we need not reckon more than 0.03 kw. hour.

The accompanying table shows the economy effected by the use of such tips, for different quantities per annum, according to B. Ludwig's observations on such plant.

Cost of Handling Coal in an Electrically Operated Tip

Tons per Annum	Cost per Ton		Capital Cost Only	
	Pence	*Cents*	*Pence*	*Cents*
8,000, Including Capital, Current and Labor	3.37	7	3.06	6
16,000	1.9	4	1.54	3
24,000	1.43	3	1.17	2
32,000	1.19	2	0.94	2
40,000	1.05	2	0.8	1
48,000	0.96	2	0.7	1
56,000	0.90	2	0.63	1
64,000	0.88	2	0.58	1
72,000	0.80	2	0.55	1
80,000	0.77	2	0.51	1
88,000	0.75	2	0.49	1
96,000	0.73	1	0.47	1

NOTE.—Pence have been converted to cents on the basis of one penny equal to two cents.

Under pre-war conditions the cost of hand labor for unloading railway trucks worked out at about 2½d (5 cents) per ton, so a tip of the above description would be economical for handling annually 13,000 tons and upward.

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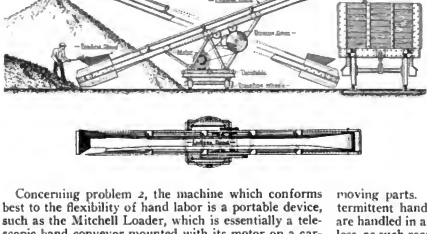
When (as in problem 2, page 190) the material, after unloading, has to be conveyed to any distance the machine proves even more economical than the man in problem 1, and this becomes increasingly evident the longer the distance and the greater the tonnage per hour. For very small installations hand labor may be cheaper, or in cases where the material has to be raised as well as conveyed. Even if there should be cases in which it can be proved that hand labor is cheaper than the machine it certainly is not so quick as the work of a conveyor, and the rapid disposal of all bulk goods at terminal points saves demurrage charges of vessels and freight cars, and on that account alone the machine would be more economical than manual labor if it could be employed at an equal rate of cost. But generally speaking mechanical appliances are more economical than hand labor, even for small installations.



Concerning problem 2, the machine which conforms best to the flexibility of hand labor is a portable device, such as the Mitchell Loader, which is essentially a telescopic band conveyor mounted with its motor on a carriage running on standard rail tracks. The conveyor can be slowed in all directions, being mounted on a turntable, and can be luffed so as to take cargo from the cars to the heap, or vice versa. Machines of this kind are made in sizes of 16, 20, 24 and 30 inches wide, from 20 to 40 feet long, and of capacities from 30 to 100 tons per hour. It is manufactured by Messrs. Fraser & Chalmers, Ltd.,

A similar machine is shown in the illustration on this page; it is however not telescopic but for fixed lengths, and is mounted on travelling road wheels and not upon rails.

In cases where the material has to be lifted to a higher level mechanical appliances are far more economical than hand labor, even in the case of very small capacities, and particularly so when the lift is higher than a man can throw with a shovel, for hand labor is then practically out of the question, for the coal would have to be shovelled into baskets, carried on men's shoulders up a ladder or gang plank and emptied, an operation which can still often be seen when ship's bunkers are being coaled One man can, in this way, only handle about one ton per hour. In connection with this performance we must remember that it is in reality the actual power capacity of the human handling machine if unaided by mechanical appliances. The basket is no machine, while the wheelbarrow must be looked upon as a primitive labor aiding machine.

If we take one ton per hour as the handling capacity of a man, we find that such simple appliances as a rope, pulley-block, and winch will increase his capacity to two tons per hour, for with nine men filling the baskets in the lighter and emptying them into the bunkers, and three men working at the winches—12 men in all—24 tons per hour can be handled. With a mechanically equipped collier having a complement of seven men in charge, coal can be transferred at the rate of 700 to 800 tons per hour, or say 100 tons per man.

With the recently erected loading scheme at Durban, one man in charge of a M'Myler Tip can handle 1,000 tons per hour, and so can the man in sole control of the loading machinery. These achievements are too obvious to require a comment and we need not haggle as to their economy. But there is one more aspect. The man in charge of such a handling machine constitutes, so to speak, the brains of the machine, his physical man power does not come into consideration, as would that of the coal-heaver who handles but one ton, and therefore girls are now frequently employed for such purposes. Now there is no reason why disabled soldiers should not be employed on such work. The writer believes that such employment would be most suitable for intelligent but physically disabled men, who could from their comfortable seat in the cabin manipulate the levers, brakes, and controls of such a conveying plant.

When handling abrasive material such as coke, and especially incandescent coke, most handling machines will require repairing and renewing to such an extent that a point must be reached when hand labor is more economical than machine labor, and this will be more noticeable in the case of continuous conveyors, where the gritty dust of the coke disintegrates and the heat distorts the moving parts. On the other hand, with such intermittent handling (where one or more tons of coke are handled in a large receptacle) the upkeep is infinitely less, as such receptacles are not so susceptible to damage, having no intricate parts, and moreover the cost of repair is much smaller in the latter case, and such repairs can generally be done by a handy man on the job.

Flexibility of the Telpher

The telpher, which is now so often used, may to some extent be compared with manual work on account of possessing the greatest possible flexibility, but when its path has once been decided upon it is fixed by its rail track, and the man in charge of the telpher performs a task analogous to the one with the barrow, only instead of having to push the barrow, the barrow—so to speak—pushes him, and instead of his barrow holding only a hundredweight or two, it will hold a ton or more. In addition to this, one man can, with his telpher machine travel at the rate of 500 feet per minute, whereas a man wheeling a barrow can only travel about 50 feet per minute. Telphers are particularly recommended where the distance is too great for continuous conveyors.

A complex handling installation is generally too expensive in first cost for undertakings of relatively small capacity, while such plant for large capacities costs but comparatively little more. Thus, for instance, an installation capable of handling 50 tons per hour, with which the writer is acquainted, cost £20,000 ($97,400), while an almost identical plant for double the capacity, i. e. 100 tons per hour, will cost only £21,000 ($102,270).

Mechanical handling devices will only become economical when certain quantities have to be handled, and with every type of machine there is a point below which hand labor must be cheaper, and the more economic a machine the lower the capacity for which it becomes economcial.

A few actual examples may be of interest. As these

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examples do not rest on the same basis they cannot be tabulated or otherwise presented in a more striking and attractive form, but they are certainly both very obvious proofs of the economy of machine handling.

Take the coal handling plant of the City Road Station of the London Electric Light Company. Here the coal arrives in barges and was formerly elevated to the boiler house floor at a cost of one shilling (24 cents) per ton, by manual labor. Now it is delivered into the bunkers at an inclusive cost of 5d. (10 cents) per ton, which also includes the water supply for driving the hydraulic crane which unloads the coal.

Another example is a coal handling plant for unloading barges by a cantilevered bucket elevator which delivers on to a drag-link or U-link conveyor, which is at work at the Corporation Electricity Works, Coventry, and was erected by Messrs. Ed. Bennis & Co., Ltd., Bolton. Before the installation of this plant manual labor was employed and the coal was raised in baskets by men out of the barge, conveyed a distance of about 50 feet on a gang plank and thrown into the store. The new installation can handle the coal with a saving of 60 per cent. over the former cost.

Expenditure Chart for Executives

By F. J. Schlink

Associate Physicist, Bureau of Standards

THE type of chart shown herewith is a mode of graphical accounting. While based on simple and well-understood principles, it has not, so far as is known, been applied in the work of the business administrator. Its use relates particularly to the needs of the administrative officers and executives, whose knowledge of financial conditions should be such as to give them control of tendencies and policies in expenditures. For this purpose, it is not necessary to know the exact balance on a given fund to the nearest cent; what is needed is a form of statement which will give very approximately the amounts of the individual expenditures, show them in their relative magnitudes, and indicate at a glance whether or not the amounts available will suffice to carry the project through the fiscal year with a satisfactory margin for contingencies; whether the proportion of administrative salaries to expenditures directly applied to production is a reasonable one, and whether the work to be done has been planned in advance as well as the data in hand will permit. No argument is needed to show the advantage of graphic methods in business management; that manner of delineation is well established nowadays and occupies an important place in modern and well ordered industrial plants and offices everywhere.

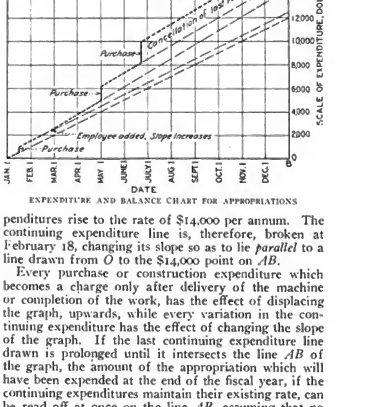
The chart, as shown, is made up of broken lines. Inclined lines represent continuing expenditures, such as salaries, insurance and rent, while vertical lines represent direct and definite outlays, such as those for furniture, machines, supplies, printing and the like. Vertical distances represent expenditures, horizontal distances, time.

For the sake of example, assume a plant having an experimental or development department for the maintenance of which the sum of $20,000 is alloted during the fiscal year of 1918. At the beginning of the year the total permanent staff of the department is such as to require an expenditure for salaries of $900 per month. In addition there are fixed charges amounting to $100 per month which includes heat, light, power, rent and insurance. The total continuing expenditure is $1,000 a month or $12,000 a year.

This expenditure is indicated by drawing a line from the origin at O to the $12,000 point on the line AB. This will be drawn as a dotted line since the expense has not yet been definitely incurred at a fixed rate, being subject to change by shifts, promotions and resignations in the personnel.

On January 15, a new testing machine is purchased at a cost, including installation and delivery, of $500. This is a single expense and when considered as a charge against the appropriation is complete on the date incurred. It will, therefore, be shown as a vertical straight line having a length equal to $500 of the vertical scale, and will be drawn from the point at which the first line drawn intersects the date line January 15. From the upper extremity of this vertical line we draw in the new continuing expenditure line, dotted and *parallel* to the first such line drawn, since the continuing expenditure is at the same rate.

On February 18, a new man is added to the force. His salary being $2,000 per annum, our continuing ex-



EXPENDITURE AND BALANCE CHART FOR APPROPRIATIONS

penditures rise to the rate of $14,000 per annum. The continuing expenditure line is, therefore, broken at February 18, changing its slope so as to lie *parallel* to a line drawn from O to the $14,000 point on AB.

Every purchase or construction expenditure which becomes a charge only after delivery of the machine or completion of the work, has the effect of displacing the graph, upwards, while every variation in the continuing expenditure has the effect of changing the slope of the graph. If the last continuing expenditure line drawn is prolonged until it intersects the line AB of the graph, the amount of the appropriation which will have been expended at the end of the fiscal year, if the continuing expenditures maintain their existing rate, can be read off at once on the line AB, assuming that no further purchases are made. The executive using the chart may, therefore, tell at a glance by visually prolonging the last inclined line drawn, whether or not the current rate of expenditure is a safe one. If the last line prolonged cuts the line AB above the limit of the appropriation, it is in effect a danger signal, and a warning that expenses must be diminished. Failing this, provision must be made somehow for increasing the allotment for the year.

Such a chart has the great advantage over the ordinary fiducial accounts that it shows not merely existing conditions but also the results which will ensue if those conditions are maintained. Furthermore, the relationship between the various kinds of expenditures is shown with a fullness and compactness which a plurality of written accounting statements cannot afford.

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Organizing to Produce Shell Forgings

Factors That Must Receive Attention, and Plans and Methods That Have Already Proved Successful

By F. E. Merriam

Only a few firms in the United States have made a success of producing shell forgings, an important item in munition manufacture. This article takes up a number of points that must be carefully considered in forging shells, including handling device for bar stock, conveying machinery and elevators for the billets and forging, manufacturing processes, inspection, upkeep of machinery, standardization of tools and maintenance of labor. The counsel is given "to make haste slowly."

Mr. F. E. Merriam is a mechanical engineering graduate of the University of Maine, and served as special apprentice and shop engineer of the plant of the Westinghouse Machine Company, East Pittsburg, Pennsylvania. For several years he has been connected in various executive capacities with the American munitions and war materials industry. He is at present with the Gulick-Henderson Company, Consulting and Inspection Engineers, New York, New York.

THE present military success of the Allies is largely due to their superiority in artillery and munitions, and as the United States comes to take a more active part in the war it will be necessary for more and more of our manufacturers to take up the manufacture of shells, which must be produced in almost unthinkable quantities. In the case of most shells forgings are necessary; but only a few firms have had experience in this work, and fewer still have worked out the process to a point where their methods even approach the best practice. Those firms which thoroughly understand the business have attained success only after much costly experimenting and a close attention to every detail. This article does not aim to cover all phases of shell-forging manufacture but only points out some of the important features of organization necessary to success.

One of the very necessary parts of the organization is the inspection department, which, if properly managed, will be found to be increasingly important and useful. The inspectors must keep constantly in touch with the quality of the product and make inspection as rapidly as the forgings are completed and to be of the utmost usefulness the inspector must be armed with sufficient authority to make the necessary changes at the presses when the quality of the product falls off. The central feature of the inspection must be to follow production so closely as to render impossible the making of more than a few defective forgings before the trouble is discovered.

Thorough Need of Inspection

The attainment of this ideal requires that a considerable percentage of the forgings be given a thorough and complete inspection; this number should be at least 15 to 20 per cent. Small size forgings can be cooled in water and then tested, but the larger sizes must be inspected hot. For this work suitable gages must be devised which will not be quickly ruined by the heat and they must be so set as to allow for the contraction which will take place when cooling has occurred. The most common defect found in shell forging practice is eccentricity. It is against this fault that the forging inspector must constantly guard. To gage accurately for this feature some form of eccentricity gage must be provided. This should be of such a design that the forging can be rotated, since such a motion will closely reproduce the turning operation which will afterward take place. The manner in which the forging is held in the gage is important and should be similar to that employed in turning.

The centering of the closed end of the forging is also an important operation, and care should be taken that the gaging for eccentricity be based upon the same principles employed in this operation, as well as all others which have any relation to turning. In these finishing operations the forging is usually held on an expanding mandrel which grips it on the inside near both the closed and open ends. The eccentricity gage should give as close a reproduction of this method as possible. Tested in this manner the turning operation on the shell will come true with the inside, inspection will be dependable and the machine-shop rejections for forging defects will be reduced to a minimum.

Such a system of inspection should not be started unless the management is willing to give it complete backing, for the machinery will be shut down more often than before for the replacement and adjustment of tools, and there will be great opposition before all concerned are convinced of the merit of such rigid inspection. However, if the system is sternly enforced its merits will rapidly become apparent to all, for the percentage of rejections will decrease and exact knowledge of what is being done will replace the former lack of information. The writer has seen the percentage of rejections reduced by this system of inspection from over twenty to less than four per cent. in a very short time. The cost of operating such a system is very small and is justified many times over.

The necessity for highly standardized operations in the machine-shop requires that the forgings be uniform in size and quality if economical operation is to be secured. Therefore, very small variations become of importance. The forging inspection department must keep in touch with occurrences in the machine-shop and adjust the inspection accordingly, with the view of constantly reducing the loss. The inspectors should also see that the rejected forgings are segregated according to their heat numbers and cause of rejection, and arrange for their disposition as rapidly as possible. Such an inspection department will relieve the shop foreman of much work, leaving him free to devote his time and thought to the problems of tooling and production organization.

Handling Material

The handling of material commences with the steel in the form of bars. These must first be unloaded from the cars and stacked where they will be readily available for use as needed. A crane equipped with a magnet is undoubtedly the most efficient and satisfactory way to handle this steel; and at least a crane should be used even if the magnet is not available, for manual labor on this job is exceedingly slow and unsatisfactory from every viewpoint. Furthermore, if a magnet is not available the bars must be piled in such a way as to allow the lifting chains to be placed readily around the material, this adds to the cost of handling. Second,

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the bars must be moved to the cutting off device. For this a crane will be found to be the most economical, particularly if equipped with a magnet. After the bars are cut into billets it is usually best to stack the pieces in boxes, or similar receptacles, to facilitate their handling which can best be by crane. For the best results it will be necessary to keep a considerable quantity of billets in stock. This can easily be done by stacking the boxes in an isolated portion of the shop.

As rapidly as needed the billets can be brought up to the furnace for heating and forging. After forging, and while still hot, the forgings should be stacked in boxes, thoroughly covered with ashes and kept in this condition until cool. In case a greater degree of softening is required it will be necessary to carry out a regular annealing operation. For this process some form of continuous furnace is most desirable. After annealing it will be necessary to induce slow cooling by packing in boxes with ashes or other similar material. During cooling the boxes should be stored in an isolated portion of the shop and near to a place where they can be conveniently separated from the ashes after cooling. To separate the ashes and forgings the contents of the boxes should be dumped upon screens which will effectually separate the forgings after which they are ready for presentation for inspection. This is such a dusty operation that it will be desirable to keep it separated as far as possible from all other work.

But a little handling will be required for the company's own inspection since the inspectors examine the forgings immediately after they leave the presses. If the purchaser has inspectors at the shop much handling will be necessary in connection with their inspection and a determination of the most economical method will be necessary if proper costs are to be attained. The solution of these problems can well command the best talent available. After inspection, including segregation into different classes, storing and loading give opportunity to economize. Here is one of the big problems. Without systematic methods of handling, production cannot go forward properly.

Conveyors and Elevators

The large quantities of forgings to be shipped and loaded necessitate well designed and thought out apparatus such as conveyors, hoists, etc., as well as the management of the labor. Gravity conveyors are convenient and efficient for placing in the cars since they can be set at the proper grade to bring up the forgings as fast as they can be handled by the men in the car. The methods of getting the forgings to the conveyor will vary with the conditions such as the relative elevations of the car and shop floors. Some forms of elevators are adapted for this particular situation. In any case something better than manual labor must be employed if congestion and high costs are to be avoided.

Shipping and loading records must be carefully thought out and planned if a true and comprehensive knowledge is to be available at all times. Accurate records must be kept of the quantities accepted for shipment as well as those shipped and, often it will be necessary to further subdivide by heat numbers. If this subdivision must be made it will be necessary to exercise care to prevent their becoming mixed. The records should be checked daily with those kept by the purchasers' representatives and any disagreement adjusted and corrected at once, before the facts are forgotten. The care and maintenance of these records should be entrusted only to responsible parties who can, and will, appreciate their importance and exercise suitable diligence in their compilation.

INTERIOR VIEW OF SHELL FORGING SHOP

Processes for Cutting Billets

In many instances it will be necessary to purchase equipment for making the bars up into billets and the choice will not only depend upon the rate at which the apparatus can operate, but also upon many other matters. Shearing is undoubtedly the most rapid method when the steel is of the proper quality, but often it is not shearable and the larger sizes of bars are beyond the capacity of most, if not all, shears. The nicking-and-breaking method is practical for all sizes and qualities of steel used for shells, and in view of the usual ruling calling for the inspection of the billets for pipes and other defects this process will undoubtedly become standard since it is rapid and furnishes an excellent surface for inspection. On the smaller sizes a sharp nick about one-quarter-inch deep is sufficient. The billets can then be broken off with a blow from a heavy sledge. Sawing is much slower than either of the methods just mentioned and, in view of the inspection requirement, is not likely to be feasible in most instances.

BULLDOZER SUITABLE FOR FORGING SHELLS
Courtesy Williams-White & Co., Moline, Ill.

In most plants hydraulic presses are used in manufacturing forgings, but large motor-driven bulldozers are also successfully employed on this work and are producing excellent forgings. For making forgings larger than five-inch the bulldozers probably would not be a success, but in the smaller sizes they well deserve careful attention from anyone equipping a plant. The bulldozer being horizontal offers the advantage of easy handling of the forgings between the different operations since the men can stand upright and do not have to hold the work at arms' length. They can always stand in an easy position. While at work they stand above the die space. The illustrations of the bulldozers

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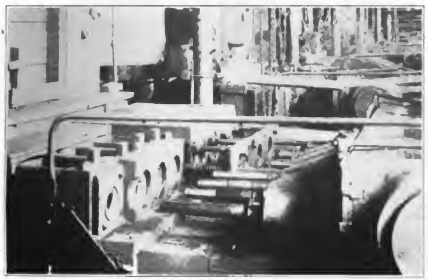
with the tools in place show how this works out. The one of the 1600-ton hydraulic press (on page 197) shows a machine not designed primarily for shell-forging work, but successfully adapted to it. The choice between bulldozers and hydraulic presses will depend upon many local conditions as well as price, deliveries, etc.



TOOLING FOR BULLDOZER AS USED IN FORGING SHELLS

Maintenance of Machinery

The maintenance of the machinery is an important item. It will be necessary to provide spare equipment to permit repairs to be made without interfering with production, and spare parts must be kept in stock ready for instant use. The machinery should be systematically overhauled and not allowed to run so long as it will hold together, since the systematic policy will result in minimum repair bills and more continuous service. The machinery must be kept in adjustment at all times, aside from that which it receives during the general overhauling.

The nature of the press tools will depend upon the manner of performing the necessary operations and their number, the nature of the equipment that will be used, etc. For example: Some firms use one operation and some two or even more, while some firms use hydraulic presses and others bulldozers. After the principles have been decided upon there will remain the working out of the details of design, class, kind and quality of material. None of these should be of a temporary nature since the service is severe, manufacturing costs high and replacements expensive in both money, time and production. All these features will, of course, require determination by experiment as well as by study. During the course of the work accurate records should be kept of the performance and changes made in order to place the choice of materials and design upon a definite basis. One important feature often overlooked, is the method of aligning the tools in the press. This, if well solved, will save much time and attendant delay in production, as well as resulting in a reduction of the costs. Another feature in the design requiring close attention is the matter of manufacturing the tools. These should be as simple as possible to bring low tool costs and rapid manufacture.

Maintenance of Labor

The human element is the most important single factor in the operation of any plant, and since conditions in a forge shop are naturally less pleasant than those prevailing in many other shops the management must give special thought and attention to the physical surroundings if a high-grade working force is to be obtained and the labor turnover kept at the minimum. The shop must be kept as clean and orderly as possible—such conditions make for high-grade workmanship and contented employees. To this end all material in process must be neatly piled, all refuse placed in receptacles provided for that purpose and regularly removed, machinery must be systematically cleaned and all passageways kept unobstructed.

Leakage of water from presses is not entirely preventable, but in most instances can be greatly reduced if a serious attempt is made. Spilling and scattering of oil should be given close attention for the sake of economy as well as cleanliness. Smoke is a major cause of the filth found so often in forge shops as to be almost considered a necessity although, as a matter of fact, it indicates nothing more than uneconomical and incomplete combustion. A careful study of this situation will result in the working out of methods that will mean greater fuel economy and more desirable working conditions. Smoke cannot be entirely eliminated where coal is the fuel, or even oil. On this account properly arranged hoods should be over the furnaces and these will effectively remove much of what remains. Frequent window cleaning will cut lighting bills and improve the surroundings. In warm weather something should be done to alleviate the high temperature conditions usually prevailing. The hoods already mentioned will be a step in this direction and shields can be set up to protect the men from the direct heat of the furnaces.

Suitable wash rooms equipped with hot and cold water and shower baths should be provided so that the men can clean up, and not be compelled to eat their lunches and go home just as they come from work. Locker rooms will, of course, be necessary and it is well to provide a clean and well lighted room where the men can eat and rest during the noonings. The central thought is to remove the objectionable features so often connected with forge-shop work and to mitigate as far as possible any that cannot be removed. Such improvements are not philanthropy or extravagance but true economy because they promote efficiency.

Standardized Methods and Tools

The large scale on which shell forgings are finished demands highly standardized methods and processes, and workmanship to very close limits. Thus the tools must be finished with greater care and to much closer dimensions and limits than is necessary in forge-shop practice. Such matters as the alignment of the press and tools must receive careful attention, and the handling of the forgings from first to last must be carried out in a new and unaccustomed manner if success is to be attained. Ideas as to what constitutes excessive scale must be reconstructed, when working to such close dimensions only a very slight scaling is permissable. To this end unusual care must be exercised to prevent scaling in the furnace and before the billet is worked any scale present must be carefully removed. The inspection already mentioned must be thorough and frequent and will keep the shop on the right track.

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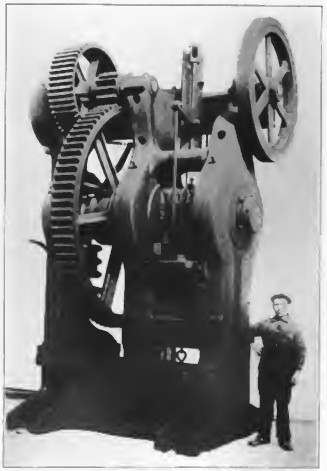
Some forgings will be produced that will not be acceptable as first class since to finish them would require deviation from standard methods. These can, however, be used with but little sacrifice of profit if proper salvaging methods are put in force. This work can be handled in two different ways, both being effective, the choice depending upon the condition of the forgings and the facilities available. Some can be most economically saved by reworking in the presses with an upsetting and redrawing operation or even, at times, by redrawing alone. In other cases a special machining method must be used. This sometimes consists of a turning operation or the forging being roughed to a much smaller size than is practicable on a large scale, while in other instances resort must be made to a special centering on account of eccentricity.

Whether the forging manufacturer should equip to do the special machining himself usually depends upon the terms he can make with the finishing shop. The finishing shop being necessarily equipped for such work a favorable arrangement can usually be made which will consist of an allowance for necessary extra work. In some instances it will doubtless be best for the forge shop to equip to handle such work for it will doubtless save some forgings that the finishing shop would not care to handle even under such an agreement. In this case the forging manufacturer will carry the work to the point where finishing can be completed by the standard operations. The finishing shop will then make an allowance for the operations completed. Since nearly all of this work will consist of turning and boring, very little machinery will be required to perform the work in an economical manner, but it should be borne in mind that on account of greater experience the finishing shop can often perform this work economically and, may not, on this account, be willing to allow enough to cover the cost incurred by the forge shop. Success in reclaiming forgings is dependent upon the knowledge of finishing and the ingenuity of those in immediate charge. The question will, of course, arise continually as to whether a particular forging is worth saving, but after some experience is gained this can become a matter of definite knowledge and record and the proper decision will not be hard to reach. Salvage work should keep pace with production to keep all matters up-to-date, and to make possible definite knowledge of the financial status of the order at all times. The fact that a forging has been saved is not necessarily proof that the transaction is a financial success, for the methods employed may cost more than the value of the forging. Accurate cost records must be kept and a degree of care and attention given equal to that devoted to production.

Disposal of Scrap

In all shops there will be some forgings that are absolute rejections and cannot be saved by any method. For these the proper course is to consider them as scrap at once, and sell them as such at the best possible price crediting the order with whatever they will bring. After a short experience such forgings can be easily determined and then the only reason for holding them is to secure a better price for the material.

At the finishing shop there will be rejections for various causes and some will be attributed to defective forgings. The wisdom of prompt decision and action was never truer than in this case, for justice cannot be done to all parties unless a settlement is made while the facts are available. On many orders handled in this country during the last few years this has not been done and there are many who can testify to the impossibility of making any equitable adjustment after a considerable period of time has elapsed. This matter should be cared for at least every week, for then all necessary facts can be secured and a proper adjustment made. The adjustment will consist of assumption of



TYPE OF SHEAR SUITABLE FOR SHEARING FORGING BILLETS
Courtesy of Williams White & Co., Moline, Ill.

responsibility by the forge shop for forgings not up to the accepted standard, and by the finishing shop of all spoiled during machining. Often forgings have been machined to a point where it is demonstrated that they cannot be finished by standard methods. In this case it will be profitable for the forge shop to pay the additional cost of finishing rather than accept absolute loss. Careful cost records must be kept if a wise decision is to be made and financial loss avoided.

Make Haste Slowly

The desire for production at the commencement of an order for the purpose of making a showing must not be allowed to outrun judgment, or the manufacturer will soon find himself with much spoiled material on hand, considerable money spent on useless tools, besides labor losses. Mistakes will be made and it is impossible to go slowly enough to avoid them entirely, but here, as elsewhere, good judgment must be exercised. If the shop is without experience in such work progress will be slow at first, even if experienced men are brought in. Many methods and tools will be found satisfactory for producing small quantities of forgings but unable to stand the test of large production. Materials and grades of materials must be tried out before acceptance and extensive use, for daily wear and tear will be found to deteriorate everything in a most surprising manner.

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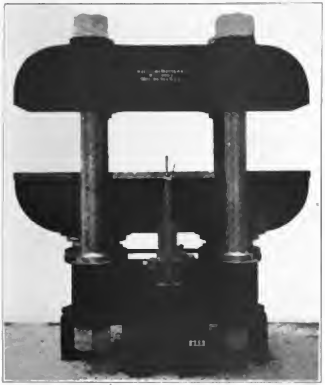
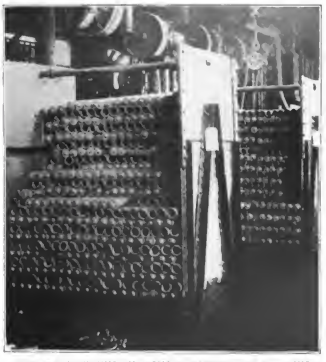
Production must be started in a small way at first and as experience is gained and men trained it can be increased. One of the most difficult things is to secure men and train them. On this account every reasonable effort should be made to retain them once they are



1600 TON HYDRAULIC PRESS SUITABLE FOR LARGE SIZE SHELL FORGING
Courtesy of Williams-White & Co., Moline, Ill.

trained. After a few men are trained they can be distributed and help in the process of building up the



TRAYS FOR CONVEYING AND STORING FORGINGS WHILE COOLING

working force. Any extensive operations with green men must certainly result in failure.

It has already been indicated that a carefully designed and operated cost system must be built up if the value of any of the methods or appliances is to be determined with certainty. Not only must such records be kept but they must be strictly up-to-date at all times, for if allowed to go far behind actual events they are of but little use, and will probably not be worth the expense incident to their maintenance. A concise statement of the financial standing of the order should be made up at least monthly. This cannot be done unless all adjustments and classifications both within and without the shop are kept up-to-date at all times. Only by the use of such a record can the present be accurately appraised and future policy definitely planned.

The purpose of this article has been not to outline the proper method of managing any particular shop, but rather to point out some of the items that must receive careful attention if success is to be attained, and to indicate how such problems have been successfully solved in different shops. The handling of a large order for forgings requires an entirely different point of view than that called for in ordinary forging work, on account of the degree of specialization required. So inspection, maintenance, welfare and many other factors must receive the same degree of attention, thought and planning ordinarily accorded only to production and tooling to achieve success in the long run.

Propaganda in Industrial Relations

By L. L. Warren

General Manager, Business Dept., Sherman Service

TODAY, as never before, appears the real need for organization. The world is learning the need of it; the United States knows it must first attain a right organization or efficiency will be sadly lacking. It is organization that must come first—planning, coöperation, standardization, effort, everything rests upon organization.

Mr. C. E. Knoeppel has, to my mind, properly interpreted the word when he says in the January issue: *"Organization is the proper relationship of human beings."* He pleads with industrial executives to study, to think of these vital laws of association, and any man, who is connected with industry so that he knows anything of the facts concerning labor, can scarcely keep from yelling himself hoarse in trying to make men think NOW.

When organization is mentioned it is usual for the mind to turn quickly to unionization as it relates to labor. But the real meaning is far different. It first rests upon individualism. As we can point to everything artificial as coming from the results of physical effort, it is right to think that the laborer and his work are the causes of a *thought brought into realization* and vitally concerned in the analysis. Without labor we cannot have industrial organization, and it is only upon the human element in labor that I desire to dwell.

Ask any executive as to the *individual production* of his workers today in comparison to a year or two ago, and you will be surprised at his answer. I am being told almost daily that the decrease amounts to 50 per cent. in many instances and 25 per cent. in many more. Surely efficiency has not gone backward during this period; surely organization has not diminished to this degree. Nevertheless, the fact is there just the same.

Some Things Beside Business

Executives have been pitting their wits against competitors, mind against mind, for so long that they have

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forgotten there is something besides commercial business in life—something besides gain, something besides power and financial strength. They have thought of labor as a necessary evil, a thing to be dealt with and considered only so much as necessary. But "human bein's is human bein's" whether they sit behind the mahogany or work with a shovel. The sooner we realize this the better. The only difference is one of knowledge made up of experience, ability, thought. Trench life has proven this to be true; a month there, and all men are equal.

Labor wants a square deal; employers want a square deal. Each really desires the other to have a square deal. But neither knows what a square deal is, and, furthermore, in many instances they do not try even half-heartedly to determine. Individual inefficiency is the result. Strife is easily started, agitation results in demands which are impossible for employers to meet. Strikes result, and whether they win or lose, the workers think discord through unionization the only remedy.

Wages Not Based on Living Costs

By performing a certain amount of work every day a worker naturally expects the same amount of food, shelter and clothing every day; but the necessaries of life are not, or have not been, based on wages. As a result the cost of living increases faster than wages. Increases in the wage scale are seldom granted without demands. Strikes seem to be the only weapon, and so labor is convinced that agitation is profitable. No matter how much the individual production of a worker increases, his income does not meet the increased cost of living. How in the world can he be satisfied? Surely no executive would allow his business to run at a loss for very long without a radical change. Why should a worker be differently minded?

Individual production cannot be efficient unless the worker is contented, unless he is earning enough to "get by." My first step in employing a representative is to know what his cost of living amounts to each month. If I cannot pay him enough salary to make ends meet, I know that he will not be able to give me the best that is in him. If I can grant him that amount to begin with, I know that it is "dollars to doughnuts" that he will work constructively, actively, because he will be looking toward an advanced income where he can enjoy a few more of the better things of life and lay aside something for a rainy day. Welfare departments are supposed to do this very thing, but many times they work backward. They act on investigative data, but do not know the workers' thoughts.

You Must Know Workers' Thoughts

You must know the thoughts of workers if you are to treat them right. You must know their desires, their home environment, their relaxations—everything about them. Then, and only then can they be taught to know that you want to give them a square deal. It is through education that you can standardize their living—it is only through practical demonstration that you can prove them wrong in the belief that strikes pay, and that you are not a dishonest employer. The question naturally arises, "Am I expected to grant every wish of employees?" Absolutely no, they don't expect you to do so, human nature is not constructed in that manner.

Your workers are no different from yourself. You like your job and they like theirs. Investigation has proven that more than 90 per cent. of workers are loyal. If they become a party to strife it is owing to mob-spirit. About five per cent. of employees are semi-loyal because of the fact that they have advanced in mentality beyond their present responsibility, something is wrong but they do not know what it is. The balance are from three-quarters to wholly disloyal.

Strikes and Losses

The usual methods which have been adopted by employment departments have been for the quick discharge of the disloyal ones. As a result of such an action there have probably been thousands of strikes which caused millions of dollars of loss. The reason these individuals are leaders is because of their being of greater mentality in comparison to their associates, therefore, they are close friends as a rule, and when discharged have a following that is surprising.

These disloyal workers can be taught, can be given better places or found places where their desires for more money can be gratified if they will devote their mind to production and not to strife. All they want is money and they can be taught that they must work to earn it. All their disloyal utterances can be successfully refuted if proper means are used. Every word they have with the contented employees simply pulls down the individual production of everyone. The same effect oppositely directed will cause an opposite result. But it has not been done, demands have been formed, made and strikes caused which have cost millions, without one single word spoken to offset the arguments.

Workers have been told what has been gained through strikes, but have you told them—mind you, I mean *told them*—what the losses have amounted to? Do shoe workers as individuals know actually how much four months of idleness upon the part of 15,000 workers, with no benefits, cost those workers in Lynn last Spring? Do shoe workers *know* that more than $4,000,000 went beyond recall? Why? The real reason, I believe, was a fight between two unions more than anything else. Do all the street car workers know how much the real loss was in the street railway strike in New York in 1916? Do coal miners know what the anthracite coal strike of some years ago really cost miners as individuals? Mr. Stevens has told of the lost days from labor disturbance in the shipyard since April. Do workers individually know?

Apply a Knowledge of the Mind

Now it is individualism that must be considered—and what is the answer. To my mind, and I am sure there are others likeminded, it is psychology—nothing more nor less than a classified knowledge of the human mind, of the mind of every worker.

The easiest way for me to make myself plain is to use our Hunnish enemy as an illustration. We have seen and are seeing what terrible havoc can be brought about through psychological effort in binding a people together, in building up individual production, in disrupting the morale of outside nations and in forcing a people to believe that right is wrong and wrong is right. We are seeing our ammunition plants blown up, our factories fired, and continuous attempts to spread throughout our nation a propaganda that is the opposite of good; all this through forcing a wrong thought, a barbarous idea, and as a result of psychological effort, promoting through a knowledge of the human mind the dirtiest, filthiest activities there have ever been seen.

Every worker today can be made to know his duty to his country, to himself and home by psychologically planned propaganda. It is the only way to bring him to full consciousness of facts, and as he responds to suggestion through contact, employers must reward his increased effort, must see that enough money is paid him to buy enough food, clothing and shelter.

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The Economy of Centralized Trucking

How One Plant Saved $50,000 a Year Through Organizing Its Factory Trucking Forces

By J. M. Van Harlingen

Factory trucking should be considered as a productive function to be controlled and supervised as carefully as any other, instead of being looked upon as an unavoidable source of expense to be slurred over as easily as possible. The centralizing of the trucking in the plant of the Fisk Rubber Company, Springfield, Mass., under one department, including the operation of the freight elevators, has brought three major results: Utilization of equipment to maximum capacity; reduction of the trucking force by some 60 to 75 men resulting in a direct labor saving of $50,000 per year; standardization of equipment to facilitate the handling of work and reduce maintenance costs, an additional saving of $5,000 per year.

Mr. J. M. Van Harlingen, after being graduated from the Sheffield School, served four years as apprentice engineer and assistant supervisor of the Public Service Railway Company; later was manager of the Transportation Department of the International Motor Company for two years; then assistant to superintendent of the New England Westinghouse Company one year. At present he is special assistant to the works manager of the Fisk Rubber Company, Springfield, Massachusetts, dealing with problems of factory organization and industrial economics.

ONE plant is today saving at the rate of $50,000 a year through a centralized trucking department. For three months before this department started operations, the conditions were studied and the field mapped out. The work was taken over gradually, and trucking in each department assumed only after operations in preceding departments had been completely organized. See Figure 1.

The trucking force in thirty departments consisted of about 175 men, most of whom were hand truckers operating every variety of equipment, each department foreman controlling his own group. In addition to these men there was the nucleus of a trucking department consisting of five electric industrial trucks operated by the maintenance department as a part of their general plant service. These trucks were used wherever unusually heavy moving was to be done, and occasionally their services were charged against the department for which the work was handled, but by far the greater amount of expense incurred was absorbed as overhead by the maintenance department.

Operation of the Elevators

The first observation which was made on plant trucking was centered about the delays. These were constant and appeared to be a natural consequence of the layout of the plant. Many were caused by elevators and it was apparent that little or no attempt was being made to regulate elevator operation or the traffic handled by them. Several studies (Figure 2) were made giving the traffic by trips and the actual time consumed. From these studies it appeared that any interdepartmental transportation system must depend for its success largely upon the cooperation of elevator service, and that it would therefore be wiser to have the operation of elevators as well as interdepartmental trucking controlled by the trucking department. This was done, and in practice our conclusion proved to be correct.

At the start the principal difficulty was with equipment. Five electric trucks were immediately taken over, three of which were of the elevating platform type and the other two of the stationary platform variety commonly known as the baggage type. It was obvious that there were enough hand trucks around the plant to more than care for the movement of interdepartmental work, therefore equipment was taken over from each of the departments as well as men used on the interdepartmental trucking. This plan was put into operation and was extremely successful. It was not realized at first to what extent the electric trucks could be used in connection with the large elevating platform, and we were immediately faced with the difficulty of securing enough of these platforms to carry out the schedule properly. The change from hand trucks with small loads to electric trucks with loads from five to seven times as large stretched the capacity of the small number of platforms to their utmost, and the work was hampered and the acquirement of more work delayed by the lack of platform equipment.

Platforms for Work

It was found that there was not in the plant a properly constructed platform that would withstand rough usage and heavy loads. Several types of platform had been used with the electric trucks, but each had proven costly to maintain. These original types cost about $7 each.

A platform was finally found, shown in Figure 3, which has proved sturdy and as light as is compatable with strength. It measures 4x5 feet, stands 12 inches from the floor in the clear and weighs a little more than 200 pounds. The first experimental platform of this type was subjected to very rough handling and as a final test it was thrown sideways on its legs from a four-foot platform to a cement drive; on the fifth throw one bolt pulled through the planking on top. Washers were then put under each bolt head, and as it now stands this platform will withstand very hard usage and will give good service. There is a corrugated steel platform made for heavy loads but it weighs more and, if damaged, would be hard to repair.

There was some question as to the proper use for the large platforms; it was found in all cases that for purposes other than permanent storage goods should remain piled on platforms until finally distributed or stocked, and that it is cheaper to provide platforms than to pay for the two handlings necessary for each transfer. It is not generally practical to use platforms for storage purposes. Following this plan the required number of platforms were assigned to each department or route, and these are used, except in case of great emergency, in that one service exclusively.

Hand trucking, which was 90 per cent. of all trucking under the old order, was done in a few departments

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by elevating hand trucks carrying small light loads, while other departments used either the traditional two-wheeled freight truck or special types of wheels. No attempt had been made to standardize and, through the system of borrowing which exists in most plants, trucks originally designed for a definite purpose were found far from their own department and utilized for odd jobs for which they were generally unsuitable. It was obvious that these trucks could not be taken out of service unless they were replaced by something else. To do this properly it was necessary to have some knowledge of what forms of truck were uniformally adaptable to a number of departments. A careful survey was made, thirty distinct types were listed and a brief description with outline drawings of each type made up for reference. See Figures 4 and 5.

During the first five months of its operation the department was occupied in "delivering the goods" and keeping the departments convinced that its service was adequate. After the first three or four departments' work had been done successfully the trucking department was solicited by others to take over their trucking.

In brief the results obtained by the trucking department are as follows:

1. Use of equipment to its maximum capacity.
2. Reduction of between 60 and 75 men in the force necessary to do the work, resulting in a direct saving in this item alone of $50,000 per annum.
3. Standardized equipment to reduce maintenance costs and facilitate ease of handling work. This item will be responsible for a saving of approximately $5,000 during the coming year.

In surveying the work of the first three months it was found that elevators had been regulated so that pleasure riding by employees was eliminated. A conductor had been placed on the large, important elevators and waiting time was almost entirely done away with. Before taking over the operation of elevators it was not unusual to find a wait of 15 minutes for ten or more men through the delays in service, and a desire on the part of the men themselves to kill time. It was found that operation of the two-gate type of elevator could be speeded up by arranging standard exits and entrances. Under the former plan of operation constant delays and confusion resulted through the efforts of truckers to enter and leave from the same side of the elevators.

Planning and Scheduling

On the interdepartmental trucking it was found that the economic movement of goods necessitated a plan of operation and a scheduling of the needs in each department served, for without planning or scheduling trucking work had been done on a one-way load basis. With the co-operation of the departments served the number of empty trips had been reduced so that few trips are now made without a load. Trucks are assigned to certain routes and operate on a schedule dependent upon the needs of the departments served. Scheduling is, of course, a matter of policy with the production departments and we were fortunate in gaining this coöperation through friendly understanding. It is generally essential that in a large plant the operating departments arrange their production as scheduled, but it is frequently not considered so necessary to deliver raw materials and supplies on a regular routine. It may, however, be the

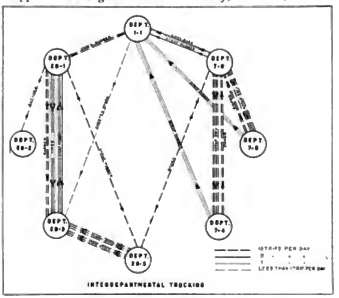

FIG. 1. CHART SHOWING INTERDEPARTMENTAL TRAFFIC

means of considerable saving in trucking expense if this is done.

As a result of the first few months' operation the saving in both time and men began to be apparent. The

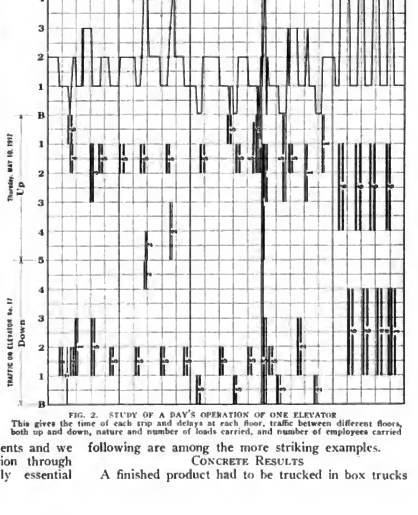

FIG. 2. STUDY OF A DAY'S OPERATION OF ONE ELEVATOR
This gives the time of each trip and delays at each floor, traffic between different floors, both up and down, nature and number of loads carried, and number of employees carried

following are among the more striking examples.

Concrete Results

A finished product had to be trucked in box trucks

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from one building to another over an inclined bridge. These box trucks had a capacity of 700 pounds and eight or nine trips a day were made with them. Five men were necessary to negotiate the bridge with this

FIG. 3. TWO TYPES OF HEAVY DUTY PLATFORMS
Used by large hand elevating and electric trucks. The one on the right is the newer type and considered the best yet developed

truck and they accompanied it through the entire route. Each trip took from half an hour to an hour and a quarter, an average of perhaps three-quarters of an hour. With the electric truck a box of 1,000 pounds

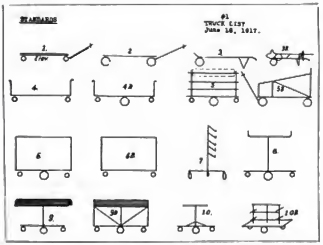

FIG. 4. ONE OF A SERIES OF CHARTS FOR CLASSIFICATION OF THE 35 TYPES OF TRUCKS IN USE

capacity is used. One man places this truck on an elevator which takes it to the location where the electric truck picks it up. By this arrangement four of the men formerly used in this work are eliminated at

FIG. 5. A FEW OF THE 35 TYPES OF TRUCKS IN USE WHEN TRUCKING DEPARTMENT BEGAN OPERATIONS

a net saving of about $3,000 per annum, after deducting electric truck charges. This saving has been made in the face of a 20 per cent. increase in the production of the department.

Boxes and containers brought from stores were formerly trucked on small hand trucks as needed, each trip requiring an hour or more. Generally four trips were made each day. One electric truck with platforms now makes two trips a day and keeps this department supplied with boxes 24 hours ahead of its requirements.

Components, formerly trucked by three men with small trucks from one department to another over a short distance, are now moved on large elevating hand trucks by one man.

In one department where 35 truckers were employed, all have been dispensed with in favor of two hand truckers and an electric truck devoted exclusively to this service.

These examples show in a concrete way what has been accomplished. There has also resulted from the close scrutiny of trucking expense a rather remarkable readjustment of labor in departments not yet affected by the operations of the trucking department. The reduction in trucking expense in these departments has been due to a feeling that reductions in the force had best be made by the department itself rather than by any outside agency. This condition would not have been brought about but for the establishment of and results obtained by the trucking department.

It is essential that in establishing a centralized trucking force some means be adopted for recording the work done and the cost of doing it.

In this case it was not feasible to establish a record of tonnage and it was therefore decided to have the performance reported on a time-and-trip basis. Later the length of trips were found to vary to such an extent that the trip record was discontinued and the trucks assigned to zones with a record kept of their time in motion. A chart of this record, Figure 7, showing the percentage of total day, in actual motion by months, is illustrative of the change that may be brought about by supervision. The average of the three elevating type industrial trucks during November was 75 per cent. while the two platform trucks average 45 per cent. during the same period. This comparative result is natural because of the time required to load and unload platform trucks while they stand idle.

FIG. 6. STYLE OF TRUCKING ORDER USED

ALLOTING THE EXPENSE

The first question as to such service is, how should it be paid for and by whom ordered? This was settled by issuing the following order:

Routine Trucking. A department requiring routine trucking will fill out an order for each type of trucking or for each commodity to be trucked during a period of one week or less.

Single Loads. Single loads or single batches of equipment, materials or finished products will be moved on special order which will specify the amount of work to be done. All charges against a department will be based on these orders and such charges will be made on an hourly basis. The rate will be dependent on the actual labor cost and overhead for the use

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of electric trucks or hand trucks. Charges will be based on the amount of time actually used from the time the truck arrives at the department until the goods have been delivered at their destination.

The trucking department assumes no responsibility for loading platforms or trailers, except where trucking order calls for such service, and delays occasioned by waiting for loads will be charged against the department causing them.

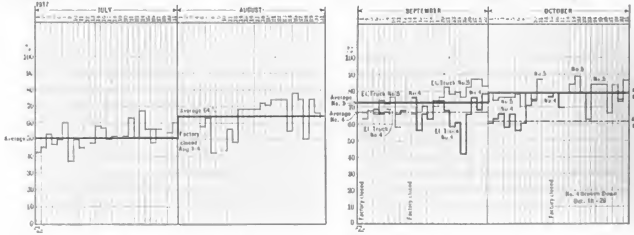

FIG. 7. CHARTS SHOWING RESULTS OBTAINED BY CLOSE SUPERVISION OF TRUCKING OPERATIONS
Each truck was equipped with a recording device to show "time in motion" and "idle time"

Making Out Orders. Trucking numbers will be numbered serially and will be made out in duplicate. The department foreman will sign these requisitions or delegate some one to do so for him.

No orders will be accepted without a signed requisition. In the case of emergency, telephone orders will be filled, and the requisition sent to the foreman for signature at the time the trucking is done. The foreman will give to the truckman both copies of the order, retaining as a check the stub from the original copy.

The trucking department will retain the original copy until the work is completed, and will then return it to the foreman giving him the amount of time charged against this order. The duplicate, which will be printed on heavier paper, will be retained in the trucking department where all the time charged against this order will be entered.

Cost Department. At the end of the week all trucking orders giving the total amount of time and the charge rate entered on them will be sent to the cost department as a basis for charging each department with the work which has been done for it.

This order form, Figure 6, was issued first weekly for routing work, but as the expense distribution was made on a monthly basis it was found to be better to make orders on the same basis which was finally done. Orders other than routine are handled by the same form, but each special order must be issued on this form and the cost charged against the order number. In order that the general manager's office may be kept in constant touch with the work, reports are made each day giving the amount of equipment work-

FIG. 8. FIVE MEN REQUIRED FOR THIS LOAD USING THE HAND TRUCK

FIG 9. COMBINATION HAND TRUCK TRAILER AND ELEVATING PLATFORM DOING THE SAME WORK

ing, the number of men employed, the breakdowns both on trucks and elevators. These reports with the exception of the breakdown report are made in duplicate, one remaining in the trucking office and the original sent to the general manager. The breakdown report showing mechanical defects and length of interruptions to service go to the chief engineer in charge of

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maintenance and equipment as well as the general manager so as to enable both to be fully informed.

REPAIRING TRUCKING EQUIPMENT

For the purpose of more accurate record it was de-

FIG. 10. HOW THE ELECTRIC TRUCK SAVES LABOR
These men with small hand elevating trucks as shown in B were hauling these drums before the new, large equipment A was introduced. Now one man does the work of three and electric trucks help where load must be carried some distance

cided to establish a card record for each piece of equipment in the entire plant whether used by the trucking or any other department. The trucking department is now responsible for the mechanical condition of all

FIG. 11. SHARP RIGHT ANGLE TURNS
PROTECTED BY MIRRORS

trucking equipment and it seemed advisable to establish some record for each piece of equipment. The advisability of making costly repairs on old equipment that has outlived its estimated life may, and should be, determined through a record of this sort. That little or no thought has been given to the matter of repairs was evident from the large number of hand trucks constantly in the repair shop. Many of these had practically to be rebuilt before being put back into service. The most casual examination showed that little care had been exercised in their upkeep, and many had been allowed to reach a state of dilapidation beyond repair. This was a case for further centralization and the trucking department finally took over the responsibility for the mechanical condition of the trucks. An inspector was put in charge of this work and given a small enclosure for storing and cleaning purposes.

A large number of trucks with small wheels were being operated carrying heavy loads and it was decided that standard wheels should be adopted and all odd sizes eliminated. It was obvious that the wheels used were too small and that they were breaking floors, door sills and incidentally themselves under heavy loads. As it was obvious that larger wheels were desirable it was decided to establish a minimum of six inches for the smallest diameter of wheels to be used, and that wherever possible the size of wheels should be confined to six and eight inches for castors and ten and twelve inches for stationary wheels. The 12-inch wheels are to be universally equipped with either roller bearings or pin bearings, and the castors are to be finished both as to the bore of the hub and the pin.

Too much stress cannot be laid upon the subject of a definite mechanical supervision over trucking equipment. It was found that the hand truck, which under normal loads and proper maintenance will require one or two men to operate, may easily become defective to such an extent that one or more extra men will be required. This matter of mechanical repair and upkeep applies also to floor conditions.

Figures 8 to 11, inclusive, show a few features of the equipment. In each case the caption of the illustration is descriptive.

The successful operation of this department shows that trucking may and should be considered as a productive division of the factory organization, instead of an overhead expense, and that it can be controlled and supervised with as good results as any other department in a plant.

Work of the U. S. Forest Service

THE following extracts from the annual report of the Chief Forester contains the following important information and throws a great deal of light upon the activities of this branch of the government:

"In the work relating to forest utilization and forest products, the resources of the service have been employed to the limit of their capacity since the war began in rendering assistance to the War and Navy Departments, the Emergency Fleet Corporation, various committees of the Council of National Defense, and manufacturers of war orders. The peace-time program has been largely discontinued. The force and the work have been centered in Washington and Madison. Every effort has been made to bring available knowledge to the attention of the organizations which have need for it and to assist in anticipating their problems."

TESTS OF WOOD

Approximately 10,000 additional tests of mechanical properties of various species of wood were made during the year, which brings the total number of tests of the character up to about 130,000.

Prior to the beginning of the war tests on methods of kiln-drying lumber were continued as in the past. A process was perfected under which hemlock shiplap can be dried to shipping condition with practically no loss of grade in 40 to 48 hours. Satisfactory results were also obtained with Douglas fir and white fir.

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Coöperative Shop Gardening

How the Whitcomb-Blaisdell Machine Tool Company Organized A Farm Project for Its Employees

By Chas. E. Hildreth

The Paxton Potato Syndicate, organized by Mr. Hildreth's firm for the benefit of its employees, sold shares at $5 each and returned to each share-holder four bushels of potatoes. This tangible result was in addition to the developing of a splendid spirit of coöperation among all who had anything to do with the project.

Mr. Charles E. Hildreth, after receiving his education at Amherst and in business became a partner of P. Blaisdell & Company in 1892. In 1895, he became Vice-President and then Treasurer of the Whitcomb & Blaisdell Machine Tool Company, and since 1915, he has been President and General Manager of that firm. He is a Director of the Worcester Electric Company. Trustee of the Worcester Five Cents Savings Bank, and a member of the corporation of the Worcester Mechanics Savings Bank. He has always been active in the counsels and affairs of the National Machine Tool Builders' Association, and for a number of years has been the Association's General Manager.

WITH the first indications of a shortage of food, the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., organized what was known as the Paxton Potato Syndicate. This took its name from the town of Paxton, six miles from Worcester, in which was a farm owned by Mr. William A. Blaisdell who had been for a number of years a stockholder in the above company. Mr. Blaisdell agreed to lease 20 acres of his farm and take charge of the planting, growing and harvesting for the syndicate.

Six hundred shares were authorized by the Whitcomb-Blaisdell Company and 400 shares sold to the employees in both the machine and foundry departments at $5 per share, and all the issued stock was taken up.

The stockholders then chose from among their number a committee of control, consisting of three from the machine shop and three from the foundry department. This committee, working with the president and treasurer of the company, directed and managed the syndicate. First, the 20 acres were thoroughly inspected by a representative of the State Agricultural Department, who advised on the soil and methods of cultivation. His advice was followed strictly. Much of the land was rank with witch-grass. Fertilizer was procured and put on, about one ton to each acre. About 15 acres were seeded to potatoes; two and one-half acres to beans; two-thirds of an acre to carrots; three-fourths of an acre to onions; one-eighth of an acre to turnips. There was produced a yield of about 2000 bushels of potatoes; 30 bushels of beans; 33 bushels of onions; 270 bushels of carrots; 76 bushels of turnips.

All the above crops were planted on the witch-grass land except the carrots, onions and about two acres of potatoes. These two acres yielded a trifle over 200 bushels to the acre.

This coming year measures have been taken to eliminate all the witch-grass and the 15 acres should then show a yield of at least 3000 bushels. An interesting feature of the witch-grass problem was the interest created in the farm among the men by taking them up in trucks after working hours and giving them the task of curbing the nuisance. The first night a load of 25 went from the foundry and the next night an equal number from the machine shop. When the foundry went next there were so many who wanted to go that it took two trucks and later three. The machinists

FARMING BY MACHINE SHOP AND FOUNDRY EMPLOYEES NEAR WORCESTER, MASS.

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never took so kindly to the work as did the moulders, but this was only natural as the character of the work was much easier for the latter and sore muscles and lame backs not so numerous. The moulders made regular picnics of it, got up songs, yells, etc., and later acquired the habit of Sunday picnics at the farm; all of which created not only a lively interest in the project but a splendid spirit among the men. When the crops were harvested each shareholder received four bushels apiece per share which at the cost of $5 gave them their potatoes at $1.25 per bushel, which was under the market price at any time this season. This was the agreement made by the company whether they made on the project or not. To help make up the defficiency the men agreed to sell the remaining potatoes and other vegetables, giving their own number the first opportunity.

Now, although this will not entirely reimburse the company for the money invested, the management feels that the investment was worth more than the money and proposes to run the farm again this summer. With all the farming implements now purchased and the witch-grass problem out of the way, everyone looks forward to much better results in the coming year.

Shop Gardening as a War Measure

How Factory Employees Can Help Increase the Food Supply

By Luther D. Burlingame

Last summer there was a two-fold incentive to cultivate gardens; The nation's food supply needed to be increased, and the high cost of living was thinning the householder's pocketbook. The problem was to increase the production of food without curtailing industrial labor or drawing upon regular farm activities. The Brown & Sharpe Manufacturing Company fostered gardening among its employees with the satisfactory results outlined in this article.

Mr. Luther D. Burlingame, *Industrial Superintendent of the Brown & Sharpe works, served a drafting room and machine-shop apprenticeship with that firm and for twenty-six years was its chief draftsman. He is an active member of the A. S. M. E., chairman of its sub-committee on limits and tolerances of screw threads, and chairman of its committee on standards and measurements. He is a past president of the Providence Engineering Society and a frequent contributor to the technical press, including* INDUSTRIAL MANAGEMENT; *also a contributor to technical societies.*

IN the spring of 1917, when a plan of coöperation was presented to the employees of the Brown & Sharpe Manufacturing Company, Providence, R. I., the company offering to secure, fertilize and plow land for gardens if the men would provide the seed and cultivate them, the response was such as to leave no doubt of the willingness, in fact eagerness, of the men to do their part. The number desiring to cultivate gardens exceeded by several times the original estimates made by those who were sponsors for the plan, so that additional tracts of land, beyond what had first been planned for had to be secured to supply even a small garden for each applicant.

The land secured for these gardens was located in three different sections of the city of Providence, but in centers where many of the workmen lived. Some of the land was leased. In other cases its use was donated by public-spirited citizens or corporations (with hearts). The Retail Merchants' Division of the Providence Chamber of Commerce, as well as the Providence Recreation Board, delegated by the city to aid in this work, gave active assistance.

Over 500 gardens covering 30 acres of land were successfully cultivated under the supervision of the Brown & Sharpe Company. It is the purpose of this article to describe the methods by which the organization was perfected and the work carried on, hoping that the experience may prove an incentive to others to carry out similar projects during the coming season, and also serve as a guide to those that do so.

That such a movement can be well worth while is shown by the fact that the crops from these gardens returned produce to a valuc of approximatey $10,000, and added to the food supply about 4000 bushels of potatoes, 254 bushels of beans, 223 bushels of tomatoes, 5½ tons of turnips, over 2 tons of carrots, 3 tons of cabbage, nearly a ton of parsnips besides beets, squash, corn, celery, etc., in large quantities. The great variety raised was indicated by a remark of the clerk working on the job of tabulating the returns from the garden at the close of the season. After a hard day's work he said that he felt as if he had been having "boiled dinner" all day.

It will be noted that the crops raised were largely staples that the men could store in their cellars for winter use, and they are proving of material help to many a family during the present winter.

The carrying out of this enterprise also encouraged the cultivation of home gardens by employees and their friends so that the total results attained were very gratifying and far exceeded the figures given.

Garden Campaign Opened

The campaign was opened by the posting of a notice, Figure 1, on the shop bulletin boards. Cards, Figure 2, were furnished to the clerks in each department on which the men could make application for gardens. The plot number was left blank on these cards until after the drawing by lot for location. In order that the men might secure gardens as near as possible to their place of residence, the plots were divided into several groups, and the gardens were assigned to those living in each neighborhood by drawing lots. After the drawing the number of the garden was filled in on the card, the required requisitions for fertilizer, and the seed that had been ordered, went through the supply department. What had been ordered was charged against the workman's account. He could then secure his supplies from headquarters at the garden. The supplies purchased in this way were obtained at wholesale prices, the men being charged only enough above cost to pay for the handling and accounting. A blue card, Figure 3, was made out for each gardener, with his name, address and plot number. This showed where he had been assigned, and became his official card to show that he or any member of his family carrying it had a right on his garden. This was one of the means used of protecting the garden against depredations, as these cards were requested to be shown whenever required, that it might be known that the worker was not a trespasser.

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After the returns had been made showing which men desired to cultivate gardens, they were called together at a noontime mass meeting and general instructions and information given as to the method of conducting the work. A Gardening Club was organized with elected officers representing, so far as possible, different departments of the shop and different plots of land to be cultivated. While the general administration of the project was in the hands of the shop Industrial Department, the Gardening Club was consulted and asked to pass on many matters which had to do with the satisfactory carrying on of the work, thus giving the men something to say as to what should be done.

Need of Starting Early

With the shortage of labor and difficulty in securing seed, fertilizer, manure, etc., in the spring of 1917, it required heroic measures to get the garden project under way within a reasonable time. As a substitute for manure, which could not be secured in the quantities needed, although several carloads were obtained by shipment from Boston, street sweepings were utilized. This material combined with sheep manure and commercial fertilizer gave excellent results.

Much of the plowing had to be done with inexperienced help although a power tractor was obtained for a part of the job. The ground was staked with stakes 2 x 2 x 18 inches long into plots, each containing from 2000 to 2,500 square feet. The numbers of the plots were stenciled on all four sides of the stakes, and as they were set diagonally at the corners of the plots, the number of each plot showed at every corner. These stakes have been left in the ground for use during the coming season, so that those desiring to retain the same garden they had last year can do so and start work as early as they wish in the spring. This makes it necessary for each man to dig over the ground for his garden instead of having it plowed; not a hard task for a small garden as the ground, thanks to last year's cultivation, will thereby be in mellow condition.

Administration of the Gardens

A young man, a practical farmer who had had training in an agricultural college, was employed as superintendent of the gardens, to have general supervision and to give instructions to those who had not previously had gardening experience. A Saturday afternoon meeting was arranged just before the gardens were ready for planting, at which Professor S. C. Damon of the Rhode Island Agricultural College gave a talk and demonstration on the cutting and planting of "seed" potatoes.

The large attendance and great interest shown at this meeting proved that the hearts of the men were in the project; in fact this was in evidence all throughout the undertaking to the end of the season.

Tool Sheds and Shelters

At the largest garden center a tool shed about 16 x 36 feet in size was erected where running water was available and a man placed in charge, so that tools could be given out on check. This building served as a shelter in case of storm, and for storing extra fertilizer and other material.

At one of the smaller gardens a tool shed was also provided. The group of 25 men cultivating this garden had a celebration and flag-raising. Figure 4 shows this garden later on, when the potatoes were in bloom.

The plan was carried out of having the main tool shed open from daylight in the morning until shortly before working hours each week day, again at noontime, from six o'clock in the afternoon until dark at night; also on Saturday afternoons and to some extent on Sundays. A charge of 50 cents was made for those who desired to hire tools and a large supply of ordinary garden implements and wheelbarrows was secured, so that men need not have the expense of purchasing a full set. This also was convenient for those coming from a distance, as all could obtain the tools on check and leave them when through their work without having to carry them back and forth, an especial advantage for those who used the street cars.

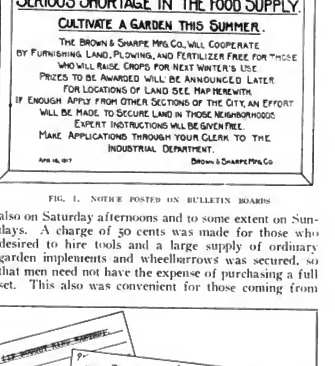
A CHANCE TO SERVE YOUR COUNTRY AND YOUR FAMILY
BY HELPING TO MEET THE
SERIOUS SHORTAGE IN THE FOOD SUPPLY.
CULTIVATE A GARDEN THIS SUMMER.
THE BROWN & SHARPE MFG. CO., WILL COOPERATE
BY FURNISHING LAND, PLOWING, AND FERTILIZER FREE FOR THOSE
WHO WILL RAISE CROPS FOR NEXT WINTER'S USE.
PRIZES TO BE AWARDED WILL BE ANNOUNCED LATER.
FOR LOCATIONS OF LAND SEE MAP HEREWITH.
IF ENOUGH APPLY FROM OTHER SECTIONS OF THE CITY, AN EFFORT
WILL BE MADE TO SECURE LAND IN THOSE NEIGHBORHOODS.
EXPERT INSTRUCTIONS WILL BE GIVEN FREE.
MAKE APPLICATIONS THROUGH YOUR CLERK TO THE
INDUSTRIAL DEPARTMENT.
APR. 16, 1917 BROWN & SHARPE MFG. CO.

FIG. 1. NOTICE POSTED ON BULLETIN BOARDS

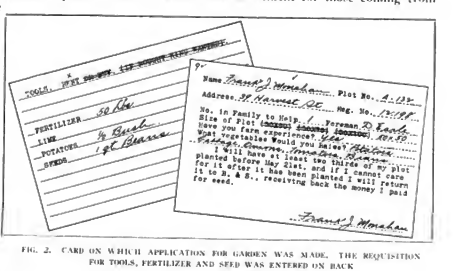

FIG. 2. CARD ON WHICH APPLICATION FOR GARDEN WAS MADE. THE REQUISITION FOR TOOLS, FERTILIZER AND SEED WAS ENTERED ON BACK

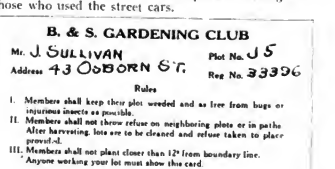
B. & S. GARDENING CLUB
Mr. J. SULLIVAN Plot No. J 5
Address 43 OSBORN ST. Reg No. 33396
Rules
I. Members shall keep their plot weeded and as free from bugs or injurious insects as possible.
II. Members shall not throw refuse on neighboring plots or in paths. After harvesting, lots are to be cleaned and refuse taken to place provided.
III. Members shall not plant closer than 12" from boundary line. Anyone working your lot must show this card.

FIG. 3. OFFICIAL "BLUE CARD" NOTIFYING OF LOCATION OF GARDEN; PROOF OF A RIGHT TO BE ON THE GARDEN LOT WHEN CHALLENGED

In many cases gardens became family affairs, and all

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the members of the family took part, either in the work or in supervision. Figure 5 illustrates this feature.

As the season advanced a spirit of good fellowship, and the forming of new acquaintances among those who found themselves cultivating neighboring gardens, was

FIG. 4. SATURDAY AFTERNOON AT ONE OF THE GARDENS. POTATOES IN BLOSSOM

one of the features which added to the value of the garden project. It was sometimes found that a laborer working side by side with a foreman could, from the gardeners' standpoint, turn the tables, become instructor and set the pace. When illness prevented some man from working and there were no members of his family

FIG. 5. GARDENS OFTEN BECOME FAMILY AFFAIRS

to help out, shopmates often volunteered and cared for his garden or even harvested his crops for him.

Instruction and Inspection

To insure the success of the gardens even when cultivated by inexperienced gardeners, careful instructions were given, not only by the superintendent in charge but by notices sent to each gardener—(see Fig. 6). Often gardens cultivated by men having had experience adjoined those where the workers were amateurs. In such cases the best of good will was shown in giving and taking advice and instruction.

Inspections of the gardens were regularly made by the superintendent, and a book record kept with an entry for each garden. This showed the condition at the time of each inspection. Whenever a garden showed signs of being neglected a notice was sent to the workman. Not only was he stimulated into bringing his garden into good condition again, but the knowledge of the fact that such inspections were being made spurred many to even greater effort so as to keep their gardens in a condition above criticism.

Depredations

Many of the men took the gardening so seriously that questions, sometimes of a petty nature, were constantly coming up for consideration and at times small troubles were magnified. On the whole, however, the best of spirit was shown, even when there were losses from theft or from straying cattle.

Every effort was made to prevent depredations, guards being employed part of the time, and the cooperation of the police department and other officials also secured. In spite of all efforts there was some thieving, but it amounted to a surprisingly small percentage of the total value of the crops raised. This did not make it any easier, however, for the person losing his crops, perhaps several bushels of potatoes, or some fine squashes in which he was taking special pride.

Among the steps taken to avoid such losses was the creating through the public press of a sentiment emphasizing the special meanness of thieving from workmen who, from patriotic motives, went to the extra labor of raising produce under difficulties, in addition to doing their day's work in the shop. A mutual insurance plan against thieving was considered but was not put into effect because of the difficulty of proving losses.

Overcoming Troubles

Men came for advice regarding all sorts of troubles, watching with "eagle eye" over the condition of their gardens and bringing in samples of various kinds of bugs and diseased plants for advice. Lice among other pests attacked the potatoes for a time. The flourishing condition of the gardens as a whole, however, gave continued satisfaction to those having the success of the project at heart. This flourishing condition was illustrated by one man who came for advice very much worried because his cabbages were growing so fast that they cracked and he wanted to know "how to stop them from growing so fast."

Through a misunderstanding in the assignments two men were located on the same lot and each had fertilized and planted it to his own liking without knowing of the work of the other. A satisfactory adjustment was made by giving these men additional land but the double-planted garden developed interesting results in mixed crops. Had there been available the wizardry of a Burbank, there might have been produced some new and wonderful crosses in the vegetable line. As it was it produced crops of high value—for one reason because of its double fertilizing.

The fact that practically all of the gardens were well fertilized had much to do with their success, as compared with the amateur garden usually encountered.

Prize Contests

As the season progressed a friendly rivalry between the different plats as well as between individual gardens was encouraged.

Eighteen prizes were offered by the company for the best crops as to size and quality. An exhibit (see Figure 7) was held, and more than one hundred entries were made for the prizes; among these were 42 pecks of A1 potatoes. First, second and third prizes were awarded for the best pecks of potatoes, the largest produced, the best beans, best dozen of parsnips, carrots and turnips, and for the largest of each of these latter

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by weight. The prizes were offered for staple crops only, it will be noted.

Prizes were also offered by the Retail Merchants' Division of the Providence Chamber of Commerce for family and individual gardens in the community, and weeds and was so wet that it could not be plowed. It was divided into small plots, however, and the men were offered an opportunity to go in and "grub it out." A number took advantage of this, trenching between the plots so that the water would flow off, and turning

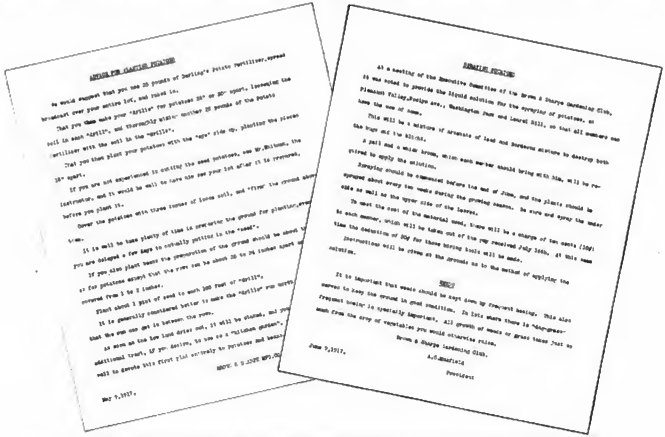

FIG. 6. SAMPLES OF NOTICES THAT WERE DISPLAYED GIVING INTRUCTIONS AND ADVICE TO AMATEUR GARDENERS

the Brown and Sharpe gardens came in for a liberal number of the awards in the classes in which they competed. A careful record of the produce of each garden, and its value, was kept, and tabulated for use in this latter competition. Refer to Figure 8.

Just at Christmas time the awards were made, $216 in prizes coming to the company's gardeners. This sum included club prizes for each of the seven sections into which the gardens had been divided, one of these sections securing first prize. By vote of the officers, the club prizes, amounting to $130 were donated to the American Red Cross. A first prize was also received by a member of the Brown & Sharpe Gardening Club for the best individual garden. Accompanying each money prize was a certificate, shown in Figure 9, page 209, which the recipients always prize highly.

Reclaiming Waste Land

The workman who won first prize not only had a successful garden where he raised potatoes and beans, but in addition he cultiviated a garden in some reclaimed swamp land that the company had secured on account of the shortage of other land to meet the gardening needs. The latter plot yielded an exceptionally good crop of carrots, parsnips, etc.; the two gardens together produced crops valued at $68.80. The use of this swamp land was an experiment and was interesting as showing large returns from what had previously been considered land absolutely worthless for garden purposes, and land which had never been previously cultiated. It was grown up to a solid mat of grass and over the sod so that it was buried beneath the soil. Lime was used liberally on this land and it yielded excellent crops without manuring. It is hoped that even better results may be obtained from it during the coming season, because of its now having been worked into a friable condition, and because it will be available to use much earlier in the season than last year. The

FIG. 7. GARDEN EXHIBIT HELD IN A SHED AT THE FACTORY AT THE CLOSE OF THE SEASON, IN COMPETITION FOR PRIZES

draining already done will help to dry it out earlier. The crops may then be matured and harvested without danger of an early frost which last year wrought serious

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havoc in this particular garden, because of its swampy location and late planting that was necessary.

Extremes Meet As Prizewinners

The second prize was taken by an amateur gardener, who, without previous experience, but with enthusiasm and industry coupled with a willingness and ability to learn, secured a crop valued at $47.60.

The opposite extreme was shown by another prize-winner, who was an experienced gardener and secured the solution drying on the leaves leaving the poison to do its work.

The largest crop of potatoes in a single garden (20 bushels) was raised on a lot which the gardener enlarged by digging up land which had been a dump beyond the plowing. The secret, however, of this large yield was that in addition to fertilizing well he buried all the sod beneath the drills where the potatoes were planted, giving the extra value of the rotting sod as food for the growing plants.

NAME	LOT	POTATOES				BEANS		TURNIPS		PARSNIPS		CARROTS		TOMATOES		CABBAGE		MISCELLANEOUS		TOTAL COST	TOTAL VALUE
		BUSHELS			VALUES	PKS. IN POD	VALUE	LBS.	VALUE	LBS.	VALUE	LBS.	VALUE	PKS.	VALUE	LBS.	VALUE	KIND	VALUE		
		1	2	3																	
Gomes, F.M.	1	4	6	4	21.60	2	.60											RADISHES CUCUMBERS	1.00 .60	7.75	23.80
Johnson, S.N.	2	4	5	1	17.00	4	1.20													4.00	18.20
Rich, Jas.	3	8	3	3	23.80	4	.75											3 Corn (3 doz.)	.45	4.00	25.00
Zurier, L.	4	9	3	2	24.80															4.10	24.80
Hird, F.A.	5	8	2	1½	20.45															3.38	20.45
Hines, H.V.	6	7	1	½	16.10															2.65	16.10
Heddle, D.	7	4½	2½	3½	18.10															4.30	18.10
Thornton, E.L.	8	2	2½	4	12.00			70	1.40			15	.45							2.50	13.85
Knight, F.C.	9	4	1¾	3	14.80	½	.20	35	.70			7½	.23							3.90	15.93
Mc Elroy, J.H.	10	7	1	2	17.60	1	.40													5.30	18.00
Rougvie, A.	11	6	1	2	15.60	½	.20	50	1.00			5	.50						.50	6.50	17.80
Nystrom, C.N.	12	2	4	1½	11.90															5.73	11.90
Hoxie, H.B.	13	3	4	5	18.00	1½ (Pkd.)	3.60	120	2.50					7	2.25	37	1.11	1-Bu Beets	2.50	7.00	29.96
Markham, E.H.	14	8	4	1	23.40	7lbs	2.52													3.40	25.92
Mitchell					21.40															4.40	23.40

FIG. 8. DETAILED RECORD OF YIELD AND VALUE OF PRODUCE OF EACH GARDEN ON WHICH AWARDS OF PRIZES WERE BASED

an exceptionally good crop even though putting the least work of any into his garden, because he knew just when to do the work and how to make it effective. He prepared the ground and cut and planted the "seed" potatoes during one Saturday afternoon, and at the end of the season harvested 15½ bushels of potatoes in a like time. He chose very hot days to hoe so that the weeds would be killed by the sun's heat, and the ground

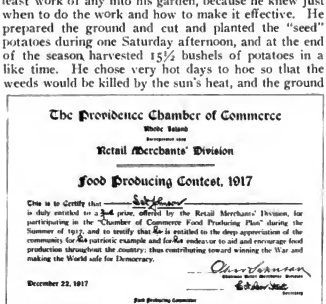
The Providence Chamber of Commerce
Rhode Island
Incorporated 1910
Retail Merchants' Division
Food Producing Contest, 1917
This is to Certify that _____
is duly entitled to a 3rd prize, offered by the Retail Merchants' Division, for participating in the "Chamber of Commerce Food Producing Plan" during the Summer of 1917, and to testify that he is entitled to the deep appreciation of the community for his patriotic example and for his endeavor to aid and encourage food production throughout the country; thus contributing toward winning the War and making the World safe for Democracy.
December 22, 1917
Food Producing Committee
HARRY E. WARD, Chairman — JOHN J. HEALY — FRANK O. FIELD — LOUIS H. PUTNEY — CHARLES LANCASTER, Secretary
Judges
HOWARD CROSBY — GEORGE H. PUTNEY — PROF. R. H. THURSTON

FIG. 9. AWARDS IN THE PATRIOTIC FOOD PRODUCING CONTEST IN PROVIDENCE

kept in condition with fewer hoeings than required by those who hoed on rainy or damp days. He chose his days for spraying so that it was done in dry weather,

The largest yield of potatoes per acre of any of the gardens was 17 bushels (mostly No. 1 grade) on a garden of 2,000 square feet. This is at the rate of about 358 bushels to the acre.

A gratifying feature was the large yield after practical farmers, and others ready to give advice, had spoken discouragingly as to the fertility of some sections of the land and predicted that crops could not be raised on it especially by amateurs. At the beginning of the season an analysis of the soil of the more important tracts had been made by the County Agent of the Farm Bureau, and advice had been given the men as to what crops could best be produced on the different tracts, also as to where and to what extent lime was needed on the land. So far as the men followed the advice based on this information they were usually successful. Some, however, tried to raise peas, green corn and other summer crops on land not suitable, and the results were almost uniformly disappointing. This shows the importance of knowing beforehand what are the conditions and conforming to them.

Precautions for Factory Gardens

When the Brown & Sharpe garden project was first considered, it was urged that it should either not be undertaken at all or else be gone into in a comprehensive way, and not with the idea of "playing at" gardening as is so often done by amateurs. It is believed that unless an industrial organization is willing to undertake such a project seriously, provide the necessary personnel and funds, and enter into it in a way to insure plans being carried out, unsatisfactory results will follow.

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Labor Factors in Our Shipping Program

How to Procure and Maintain Shipyard Workers and Hasten the Building of Our Emergency Fleet

By Roy Willmarth Kelly

A force of 250,000 men is to be enrolled to build our emergency fleet, of which some 1,500 vessels are under construction in 132 shipyards. The real obstacle to manning these yards is the excessive labor turnover. In a few cases a sufficient number of men have been secured, employment and service departments have been established, housing has been looked after and methods of training set up. All of these points are helpfully discussed in this article from the background of actual results.

Mr. Kelly has had extensive experience in technical and industrial training, including the positions of acting principal of the Technical High School, Fall River, Massachusetts, vice principal Pacific Grove High School, Monterey County, California, and director of vocational guidance in the pre-vocational schools of Boston, Massachusetts. He is now Director of the Bureau of Vocational Guidance of Harvard University. At the request of the Emergency Fleet Corporation, this Bureau has recently completed a book describing the leading shipbuilding trades and giving an account of the experience and general qualifications necessary for them with the object of recruiting a large body of workers and giving them all available information.

REPORTS of two significant shipbuilders' conferences have been published by the Industrial Service Department of the Emergency Fleet Corporation. Both of these conferences devoted the major part of their attention to four problems: 1. Scamping, or the practice of taking men from other yards; 2. Locating and distributing the available supply of labor; 3. Employment and service departments in the ship yards and the preparation of personnel executives; 4. An industrial training program for workmen.

The results which have been attained following the recommendations of these two conferences are of far reaching importance, not alone to the shipbuilding industry, but to all employers. They are of permanent interest to any satisfactory solution of our labor difficulties and, for that reason, the efforts of the industrial branch of the Emergency Fleet Corporation to tide over the war crisis in the ship yards are of much more than temporary consequence.

> We shall build good ships here,
> At a profit if we can,
> At a loss if we must,
> But always good ships.
>
> *Collis Potter Huntington.*
>
> This inscription is on a stone tablet in the ship yard at Newport News. It is a splendid motto for Liberty shipbuilders.

Those who are familiar with the turnover figures from the steel mills, building trades, structural steel work, and other occupations similar to those found in ship yards, will appreciate the extent of the task faced by the shipbuilders. Chairman Edwin N. Hurley of the Shipping Board recently stated before the Senate Investigating Committee that a total of 1427 merchant vessels were under construction in 132 different ship yards. These yards and the fabricating plants supplying them are scattered over 25 states, from the Atlantic to the Pacific and from the Lakes to the Gulf. On January 1, 1917, seventy-four of these yards existed only in contracts and blueprints. Several are now employing from 10,000 to 12,000 men each. When completed, the Hog Island yard near Philadelphia will require over 35,000 employees. To point out that in the nine weeks beginning October 6, 1917, the number of men engaged in 109 yards was increased by 45.2 per cent. shows at once the magnitude of the recruiting program.

Can Enough Men Be Found to Build Our Ships in Time?

The accomplishments of a few yards where the working force has been built up successfully with little or no Federal aid shows that there are plenty of capable men available. The Fore River plant of the Bethlehem Steel Corporation had 3,700 men on its pay rolls in May, 1917. On December 7, 1917, the total had been increased to 10,253. This was brought about almost wholly by machinery already in force which had not been used by other manufacturers. Among the means utilized were coöperation with Federal and State employment offices, the Y. M. C. A., and educational institutions, advertising at the state fairs, and developing an employment and welfare service and advertising in a perfectly legitimate way.

Mr. Morgan, who had charge of constructing the canonment at Ayer, Massachusetts, and who has had experience in building wooden ships, has this to say of the supply of carpenters and shipwrights:

> "At the beginning of the war, I was delegated to cover New England and get a line on the men who were willing to take up government work. According to the statistics of our general secretary, there are about 35,000 competent ship carpenters registered from different parts of the country belonging to our union. . . . There are 65,000 organized carpenters in New England."

It is only fair to suppose that many of the men referred to by Mr. Morgan could readily undertake shipyard work.

During the month of October, 1917, Federal employment bureaus placed 45,000 people in productive industries. In November of last year, Mr. C. T. Clayton, Chief of the Federal Employment Service, stated that 146,000 men were then listed who were willing to take up employment in different parts of the country.

With the present extended organization of Federal labor reserves and the excellent work being done by the National Chamber of Commerce and other organizations, there seems to be every reason to suppose that it will be possible to locate enough men who are willing

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Check the following trades at which you have worked with an (✓) and write the number of years experience in column marked (LENGTH OF EXPERIENCE). If you are working as a helper write (H) after the trade, if foreman write (F) after the trade. If pusher write (P) after the trade. Double check the trade you are most skilful in and give the RATE you received.

	TRADE	LENGTH OF EXPERIENCE	RATE		TRADE	LENGTH OF EXPERIENCE	RATE		TRADE	LENGTH OF EXPERIENCE	RATE		TRADE	LENGTH OF EXPERIENCE	RATE	
1	Acety Welder				21 Pipe Coverer				41 Shearer				61 Switchman			YARD
2	Boiler Up				22 Plumber				42 Shipsmith			SHOP MEN	62			
3	Caulker & Chipper				23 Sheet Met. Wor.				43 Templet Maker				63			
4	Driller & Reamer			CONSTRUCTION	24 Ship Rigger			FITTERS OUT	44 Toolmaker				64 Boatman			GENERAL
5	Fairer				25 Sign Painter				45				65 Inspector			
6	Com Riveter				26 Staging Builder				46				66			
7	Packer				27 Steam Fitter				47				67			
8	Passer Boy				28 Tinsmith				48 Brakeman				68			
9	Rivet Heater				29				49 Chauffeur				69 Bricklayer			CONSTRUCTION MEN
10	Ship Fitter			HULL MEN	30				50 Conductor				70 Carpenter			
11					31				51 Elec. Craneman				71 Cement Worker			
12					32 Bench Hand				52 Elec. Derrick Operator				72 Lather			
13					33 Blacksmith				53 Fireman			YARD MEN	73 Metal Lather			
14	Coppersmith				34 Furnace Heater				54 Fireman (Protec.)				74 Plasterer			
15	Deck Fitter				35 Lathe Hand			SHOP MEN	55 Garage Mechanic				75 Steel Iron Worker			
16	Electrician			FITTERS OUT	36 Machine Hand				56 Gasoline Engineer				76			
17	Joiner				37 Machinist				57 Guard				77			GENERAL
18	Layer Out				38 Mach. Riveter				58 Loco. Crane Engineer				78 Laborer			
19	Painter				39 Puncher				59 Locomotive Engineer				79			
20	Pipe Fitter				40 Roller				60 Stationary Engineer				80			

Note below any other position you are qualified to fill, the name of the firm by whom you were employed, the rate of wages you were paid, the date of entering and leaving this employment, and the reason for leaving.

Signature _____ Address _____

Date _____

Should you change your address, secure employment elsewhere or do not wish to be retained on live list, please notify us so we can change our record.

COMBINED APPLICATION BLANK AND EMPLOYEES' RECORD CARD

to do the work of the yards. But this does not end the crisis. Many of the yards are now producing much less than their maximum output due to lack of labor. The situation has been complicated by cold winter weather and the coal shortage. It will become more acute as the new yards now being rushed to completion call for their full allotment of workmen.

Labor Turnover: The Real Obstacle to Manning the Ship Yards

At the Ship Yard Employment Managers' Conference in Washington last November, Admiral Capps made this significant statement: "In 64 yards of which we have recently had accurate data, the turnover averaged 235 per cent., and probably was 300 per cent. at the last report. You can well realize what this means in the volume of men passing through our works in the course of a year without any adequate return in labor." This proportion probably holds true in other establishments not reported.

Although these figures represent the turnover during the construction period and under bad weather conditions, there is ample rea-

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son to believe that large labor fluctuations are still going on.

Accepting the conservative estimate of 500,000 men needed in the ship yards, the total number to be hired every year if this turnover persists will far exceed the number that can be spared even temporarily from other necessary occupations.

Some light is thrown on this situation by Table I. The figures there given were compiled from a yard where conditions were exceptionally good. They represent a turnover much less than could be expected to obtain after the yard had trebled in size. It is important to note that the bulk of the men whose term of service is less than one year are in the very large departments of the steel mill and outside hull construction. Several of the shops make an equally disturbing showing.

It should be remembered that this table is only suggestive of the amount of the turnover, since it gives a view of the situation on a given date and does not take account of fluctuations during the year.

Expressing the term of service from such a table as an average does not properly describe employment conditions. To say that the average term of service is 2.6 years, balances a few long term employees against a large number who have been in the organization only a few weeks. The median (the point above and below which there are an equal number of employees when they are arranged in order according to length of service) falls in this case within the one-year group. It is much nearer the truth, therefore, to state that in this plant the median term of service was less than one year, probably only 10 or 11 months.

If these conditions obtained only in the ship yards, the matter would be of comparatively slight consequence. But such is decidedly not the case. Employers everywhere, and especially large manufacturers, face exactly the same situation.

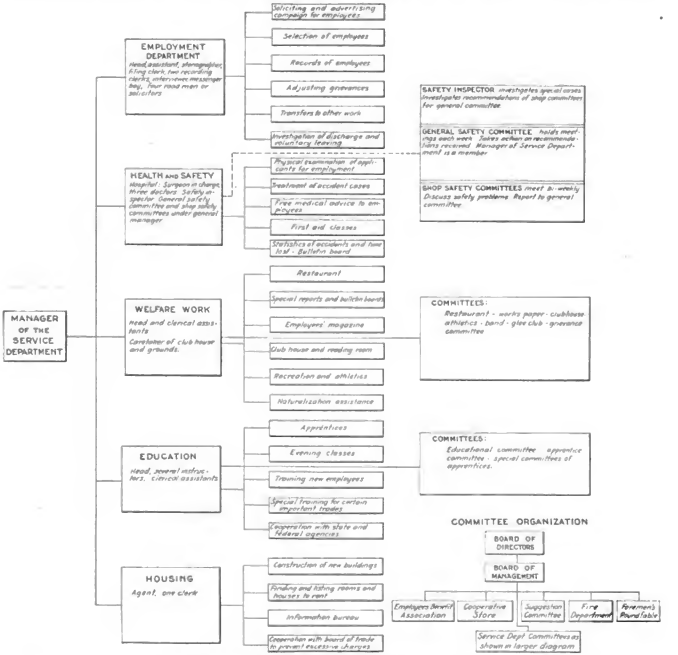

DIAGRAM SHOWING WORK DONE IN DEVELOPING PERSONNEL MANAGEMENT

Some Preliminary Measures

To reduce the wasteful migration of labor, "scamp-

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ing" has been prevented in the Navy Yards by an executive order. This prohibits the engagement of any man who has been working for a concern on government contracts within three months of the time of his application without a written release from that firm. An agreement has been entered into by the yards under the Shipping Board by which a similar release must be given in the form of clearance papers from the local Federal or State employment bureau in the district where the man was last engaged.

ing, and a widespread publicity campaign, the Chamber has done a great deal toward making the men in the yards appreciate the light in which their tasks ought to be regarded by the people at large.

SHIP YARD EMPLOYMENT AND SERVICE DEPARTMENTS

TABLE 1

TERM OF SERVICE OF EMPLOYEES IN A SHIP YARD—NOVEMBER 23, 1916

Average Term of Service—2.6 Years; Median Term is Less than 1 Year

Department	Under 1 Year	1 Year	2 Years	3 Years	4 Years	5 to 10 Years	Over 10 Years	Total No. Employed	% Under 1 Year	% 1 Year or Less	% Over 10 Years
Executives and Office Force	48	31	20	16	5	30	39	189	25.4	41.8	20.6
Drafting	37	25	9	11	10	21	6	119	31.1	52.0	5.0
Totals	85	56	29	27	15	51	45	308	27.6	45.7	14.6
Blacksmiths	15	15	8	5	2	11	8	64	23.4	46.9	12.5
Pipe Shop	79	87	28	36	13	11	1	255	31.0	65.0	0.4
Electrical Department	20	20	11	18	9	9	7	94	21.3	21.3	11.7
Power House	8	3	5	2	2	3	1	24	33.3	45.8	4.1
Foundry	**38**	**9**	**10**	**6**	**3**	**3**	**0**	**69**	**55.1**	**68.0**	**0.0**
Shipwright	**45**	**10**	**8**	**7**	**6**	**18**	**9**	**103**	**43.6**	**53.4**	**8.7**
Pattern Shop	**21**	**8**	**4**	**2**	**3**	**4**	**6**	**48**	**43.7**	**60.4**	**12.5**
Joiner Shop	**38**	**14**	**14**	**6**	**2**	**14**	**1**	**89**	**42.7**	**58.4**	**1.1**
Sheet Metal	9	39	16	10	9	13	1	97	9.3	49.5	1.0
Machine Shop	63	109	66	15	26	80	34	393	16.0	43.8	8.6
Paint Shop	**49**	**14**	**6**	**2**	**1**	**17**	**0**	**89**	**55.1**	**70.9**	**0.0**
Outside Machinists	26	42	18	16	17	19	6	144	18.1	47.2	4.1
Riggers	23	12	15	5	5	11	9	80	28.7	43.7	11.1
Outside Hull	**501**	**133**	**90**	**44**	**28**	**43**	**13**	**812**	**61.7**	**78.0**	**1.6**
Storage and Warehouses	**20**	**13**	**1**	**3**	**3**	**6**	**1**	**47**	**42.5**	**70.3**	**2.1**
Boiler Shop	**29**	**10**	**2**	**8**	**4**	**9**	**4**	**66**	**43.9**	**59.1**	**6.0**
Steel Mill	353	86	36	26	27	37	8	573	61.6	71.6	1.4
Yard Maintenance	**57**	**26**	**13**	**5**	**5**	**12**	**7**	**125**	**45.6**	**66.4**	**5.6**
Yard Totals	1394	650	309	216	165	320	116	3170	40.1	64.6	3.6
Totals	1479	706	338	243	180	371	161	3478	42.5	62.8	4.6

With the advice and assistance of the Industrial Service Department of the Emergency Fleet Corporation, much has been done during the past few months to improve employment conditions in the yards. Regular reports are being received in Washington which show the extent of the flow of shipbuilding labor, and the special needs of each plant are being carefully considered. Professor Carroll W. Doten has been called from the Department of Economics of the Massachusetts Institute of Technology to assist in supervising the collection and interpretation of statistics. Numerous conferences have been held with representatives of the yards who are dealing with the question of labor supply, and suggestions and assistance are constantly being given to managers and superintendents who are striving to find and train men and keep them steadily at work.

The measures so far taken are quite certain to fail of their intended objective unless every plant is brought to see the need for systematic study of its own problems of labor maintenance. Relatively few of the yards have any organization by which such a study can be carried on. For many years shipbuilding was not a highly profitable industry and on that account relatively little progress has been possible in some of the newer forms of management. In many cases, hiring and discharge are still

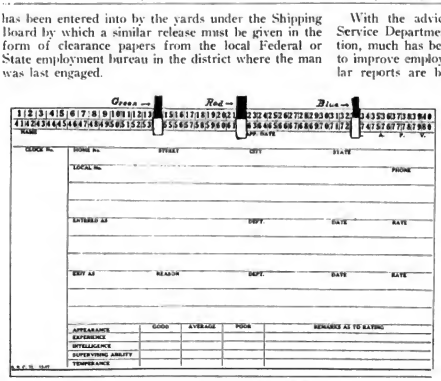

FIG. 3. EMPLOYEE'S RECORD FOLDER
The original is a 5 x 8 folder of heavy manilla paper

Some very effective work has been done by the Chamber of Commerce of the United States. Not the least valuable part of its contribution has been the creation of increased enthusiasm for the shipbuilding program. By posters, badges worn by those engaged in shipbuild-

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in the hands of foremen who are already greatly overtaxed by the constant pressure for increased production.

The Union Iron Works at San Francisco, The Submarine Boat Corporation of Newark, and The Newport News Shipbuilding and Dry Dock Co., are among the

the first line space of the folder, shows the trade the workman is skilled in. Similarly, yellow tags placed on the second line show trades from 41 to 80 in which the workman has had experience.

When an additional worker or workers are wanted in

THE MOLD LOFT IN A LARGE MODERN YARD BUILDING STEEL SHIPS
Lines for every part of the hull are laid out on this floor to full size scale. Wooden templates are then made from which the structural steel is marked by the ship fitters

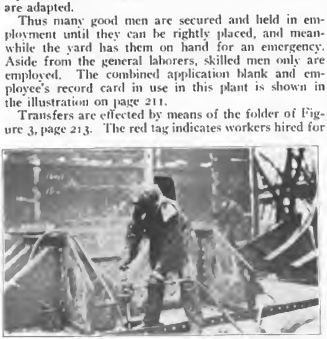
yards that are active in developing personnel management. A diagram showing the work done by one of the Bethlehem concerns is given on page 212.

Some Suggestions from the Submarine Boat Corporation

Men applying for work in a particular trade at the Submarine Boat Corporation are given that work if possible. If there is no available opening, they are given a job of a similar nature, or any work for which they are adapted.

Thus many good men are secured and held in employment until they can be rightly placed, and meanwhile the yard has them on hand for an emergency. Aside from the general laborers, skilled men only are employed. The combined application blank and employee's record card in use in this plant is shown in the illustration on page 211.

Transfers are effected by means of the folder of Figure 3, page 213. The red tag indicates workers hired for



A REAMER AT WORK
Ninety per cent. of riveting, drilling, reaming, and calking is done with pneumatic tools

trades from 1 to 40, and is placed in the first line space on the folder. The blue tag placed on the second line, is for workers hired for trades numbered from 41 to 80. A green tag placed on numbers from 1 to 40, on

any part of the plant, a demand is made upon the employment department, which first consults the employment records in the folders. Before taking on new men, transfers are made of those who can be spared from the departments in which they are working, or who properly belong in the work for which the call comes.

This all saves time in securing new men and expedites work in the yard. It also creates a good feeling toward the company on the part of the worker because it means placing a man finally where he is best fitted to be.

Full provision is made for housing by a careful study of all available houses, boarding-places and rooms. Applicants for positions are kept over night if necessary, or they are taken care of at once. Arrangements are being made for housing at more distant points, outside of Newark, as the number of workers increases. Special trains are to be run into New York night and morning to carry employees.

In many of the other yards not so fortunately located housing has become one of the most pressing problems. Barracks and cottages are being built by several of the shipbuilding concerns and plans are under way for extensive housing provisions at government expense.

Training Employment Managers

One of the serious drawbacks to putting the best employment practice into effect is the lack of trained employment managers.

Large concerns everywhere are awake to the need and are seeking men with the right ability and preparation to take charge of newly organized employment and service departments.

Colleges and technical schools ought to appreciate the presence of this urgent demand and plan to offer the right kind of intensive training for workers in this field. Here is clearly one of the places where service of the most valuable kind can be rendered.

The Kind of Workmen Needed in the Ship Yards

At the request of the Emergency Fleet Corporation,

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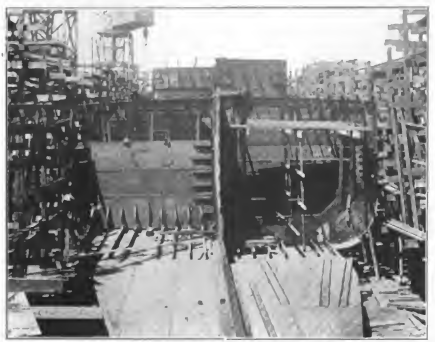
the Bureau of Vocational Guidance of Harvard University recently prepared a brief description of the leading shipbuilding trades. The purpose of this publication is to give in simple form an account of the work done in each department and of the experience and general qualifications men ought to have who apply for positions.

AN AUTOMATIC PUNCHING MACHINE IN THE STEEL SHOP
This machine punches rivet holes in the plates, or "strakes," for the hull of the ship

Little or nothing of interest to the lay reader has been published regarding the operations involved in shipbuilding, or of the conditions confronted by those who engage in it. Through this study, material is now made available which will assist men in deciding for themselves the probability of their proving successful in these trades.

In the course of the Bureau's investigations, some interesting changes now in progress of development in the methods used by shipbuilders were brought to our notice. One of these relates to practices in the mold loft. Here full size templates of wood or paper are made for laying out the steel plates and frames used in ship construction. It was formerly supposed that only men of many years' experience could be used for laying out the lines on the floor from which the templates are made. The special difficulty lies in the presence of curved surfaces, but all classes of mold loft work do not present these problems. Several progressive yards have discovered that it is entirely practicable to apportion the work in such a way that the lines and templates for all flat work, such as bulkheads and certain parts of the hull, can be handled by carpenters, structural steel men, or sheet metal workers.

Young high school and trade school graduates are being trained as shipfitters on classes of work that were previously given to highly trained men. Thus in several branches of the industry, subdivision and analysis of tasks have made it possible to put men at work after a few weeks of intensive training on what were formerly regarded as highly skilled operations, requiring long experience.



A STANDARD OIL TANKER UNDER CONSTRUCTION
Under ordinary conditions, it took 6 months to get the ship to this stage. In 1917 the Union Iron Works completed the 10,000 ton steel ship Paulsboro in 119 working days

Where Workmen Are Most Needed

It is impossible to make any general statement that will apply throughout the United States as to the shipyard trades for which men are most in demand. Since there is an insufficient supply of experienced shipyard workmen, men from similar outside trades must be taken over and trained as quickly as possible. In the publication above referred to, the Bureau of Vocational Guidance has listed over 80 industrial fields outside of shipbuilding, from which men can be called who will have had a useful background of experience.

The table of the distribution of employees, Table 2, gives some idea of the extent and variety of the occupations involved. Hull construction, the steel mills, machine shops, boiler shops, foundries, and yard maintenance are among the departments in the yards most likely to be short of men.

The new yards will obviously need a full quota of men for every department. Taking men to become leaders in these yards, has depleted the supply of skilled men in the older plants and made it necessary for them to enter upon a campaign of training.

Distribution of Employees

Table 2 gives a distribution of the workmen in the leading departments, exclusive of the office force, in five typical yards building steel ships. Although these figures do not cover enough yards to prove anything conclusively, nevertheless, they raise an interesting question.

It will be noted that wide variations appear among these yards in the number of employees engaged in a given department, as compared with the total number on the payroll. In some cases these deviations can be explained on the basis of differences in the character of the work being done. Nevertheless, it seems likely from the statements of employment managers and from a general analysis of the situation, that

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at no time within the last year have the larger yards been able to so regulate the number of men in each of their departments as to reach a maximum efficiency in production. A thorough examination of similar statistics from all the yards ought to be made to furnish the basis for a more careful regulation of the proportionate number of workmen to be placed in each division. Extended study of this problem in each yard ought to result in much better coördination of effort in addition to a considerable saving in labor.

A TYPICAL BOILER SHOP OF A LARGE SHIP YARD
The yards are building 7,8-ton Scotch boilers as well as water-tube boilers of the Yarrow and White-Forster types

Training Workmen for the Ship Yards

At Newport News a training center for shipyard instructors has been established. All the yards engaged on work under the Shipping Board are invited to send experienced men to the school whom they wish to have trained as instructors. After four to six weeks of intensive training in practical pedagogy, these men return to their own plants and take up the work of breaking in new employees.

Many of the methods of instruction in use are based upon the experience of the Navy Yards extending over a period of years. Additional plans and courses are being developed which can later be utilized in establishing similar schools elsewhere.

The employment department of the Harlan and Hollingsworth plant has drawn up a plan by which 30 men are to be brought from Cornell University to undertake training in the yard during the spring of 1918. These men are in the senior class of the engineering courses. Because of the great variety of experiences to be derived from the numerous shops and the many classes

TABLE 2
NUMBERS AND PER CENT OF EMPLOYEES IN THE LEADING TRADES OF FIVE TYPICAL STEEL SHIP YARDS

Department	Yard No. 1		Yard No. 2		Yard No. 3		Yard No. 4		Yard No. 5		Total Average	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Anglesmiths	23	0 5	37	0 8	27	1 1	25	6	*		112	0 6
Blacksmith Shop	103	2 3	54	1 1	63	2 7	40	9	61	2 1	324	1 7
Boiler Shop	135	3 0	70	1 4	116	4 9	128	2 9	65	2 2	514	2 7
Erectors and Bolters-up	615	13 7	400	8 1	*		*		*		1015	10 8
Calkers and Chippers	217	4 8	196	4 0	91	3 9	255	5 8	*		759	4 7
Copper Shop	18	0 4	39	0 8	61	2 6	80	1 8	*		198	1 2
Drillers and Reamers	264	5 9	441	9 0	530	23 4	450	10 1	*		1685	10 4
Electrical Shop	154	3 4	142	2 9	41	1 7	125	2 8	94	3 1	556	2 9
Fitters	149	3 3	215	4 3	128	5 4	210	4 7	*		702	4 3
Foundry	*		69	1 2	*		51	1 3	69	2 3	187	1 5
Galvanizing	27	0 6	*		*		7	0 2	80		34	0 4
Joiner Shop	105	2 3	32	0 6	47	2 0	157	3 5	89	3 0	430	2 5
Machine Shop	479	10 7	983	20 0	176	7 5	563	12 7	593	13 2	2494	13 0
Mold Loft	88	1 9	46	0 9	24	1 0	45	1 0	*		203	1 3
Naval Architecture	*		86	1 7	*		46	1 1	119	4 0	251	1 8
Outside Machinists	141	3 1	250	5 0	33	1 4	*		144	4 8	568	3 9
Paint Shop	179	4 0	134	2 5	45	1 9	198	4 5	89	3 0	635	3 3
Pattern Shop	51	1 1	62	1 3	20	9	42	1 0	48	1 6	223	1 2
Pipe Shop and Plumbing	221	4 9	206	4 2	47	2 0	256	5 8	285	8 5	983	5 1
Riggers	115	2 5	121	2 5	20	0 9	296	6 7	80	2 7	632	3 3
Riveters	551	12 3	564	11 4	324	13 8	490	11 1			1929	11 9
Sheet Metal Shop	82	1 8	170	3 4	38	1 6	60	1 4	97	3 3	447	2 3
Shipwrights	194	4 3	277	5 6	50	2 1	398	6 7	103	3 5	922	4 8
Steel Mill	292	6 5	*		203	8 6	252	5 7	573	19 2	1320	9 3
Yard and Ship Laborers	280	6 3	330	6 7	205	8 6	253	5 8	125	4 2	1193	6 2
Oxy-acetylene	*		15	0 3	19	9	12	0 3	*		46	0 4
Total Number of Workers in these Departments in the Yard	4483		4933		2358		4439		2981		19191	

*No satisfactory data supplied.

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of work represented by a ship yard, it is felt that students in such courses can obtain an excellent opportunity for practical experience.

Two divisions will be made of the students. Those who are primarily interested in mechanical engineering will go into the engineering department. They will become accustomed in the course of a few months to the assembling and erection of machinery, boiler testing, trial trips, and other experience that would probably take three or four years to obtain in the ordinary way. Those who are interested in structural steel work, or in drafting, will go into the drafting room, or into the mold loft. Some of them will be taken on as ship fitters.

In the evenings special lectures by college professors and practical men in the shipbuilding industry will be given for each group. These lectures will also be open to foremen, leading men, and others in the yard who are capable of profiting by them. They will be so planned as to follow up the work done by the students during the day.

It is hoped that the Harlan and Hollingsworth plan will prove to be another practical means of training leaders and instructors that can be adapted to the needs of other yards.

HOLDING MEN IN THE INDUSTRY

The interest already manifested and the aggressive methods adopted by the Emergency Fleet Corporation, by the Labor Department, and by individual yards show that a large supply of labor can be recruited and trained in a short time. It is questionable whether an equal amount of attention has been given to keeping men steadily at work. The outstanding factors in this part of the program may be summarized as follows:

The initial selection of men must be so regulated as to accord fair and courteous treatment to all who apply. In no other way can men be encouraged to volunteer for shipyard service.

Transfers and promotions must be effected quickly and equitably. This implies better office methods than are now in use in the majority of our large industrial plants.

The crisis demands, and men have a right to expect, that steady employment will be provided. A large shipyard may be spread over several hundred acres and includes 18 to 20 shops and mills, numerous storehouses, docks, power plants, and an extensive transportation system—all necessary to the central work of erecting ships on the ways. Only by carefully coördinating these activities, can layoffs and delays be prevented. Training gangs of men who can be shifted into any one of several different kinds of work is one means of reducing lay-offs or temporary idleness due to weather conditions or operating emergencies.

Local transportation systems must be improved so that men will not be unnecessarily delayed in going to and from their work. One morning recently at a New England yard, nearly a quarter of the total force were from five to twenty minutes late because of poor street car service. Nearly 500 men returned to their homes rather than suffer the customary fine of an hour's pay. A serious transportation problem has confronted this yard for months and an equally unfortunate situation exists in many other shipbuilding centers.

The severe exertion of the work requires that men must be well fed and housed if they are to be kept in good health. Many of the yards have no suitable restaurants in or near the plant where a nourishing lunch can be procured at noon.

Medical and physical examinations should be used as a basis for the selection of employees, and a well equipped dispensary and hospital are indispensable to the welfare of the men. Hundreds of men can be saved to the industry every month by attention to this one factor.

Participation in management through a committee organization such as that suggested by the diagram on page 212, creates a better spirit among the men and helps executives to locate trouble before discontent spreads too far.

We are agreed that our army cannot be effective unless high standards of morality are maintained. So long as our shipbuilding committees tolerate vice and drunkenness, we cannot expect to create either a stable or an efficient working force.

Much of the appeal in securing workmen for the yards has been patriotic in its nature. This is properly the case. It ought to be understood by every man who performs any task in a shipyard, great or small, that he is engaged in work that is of supreme national importance. Only by coöperative effort and willingness to endure a few temporary hardships can we build our victory fleet and build it quickly.

The Price of Safety Against Fire

By Charles Hill

WHEN in charge of a plant using quantities of nitro cellulose, I found that the fire danger was reduced to the lowest degree by the following: 1. Fire extinguishing appliances; 2. Care of stock; 3. storage of supplies; 4. care of waste; 5. cleanliness; 6. inspection.

1. FIRE EXTINGUISHING APPLIANCES. The overhead sprinkler system, installed when the building was built, was kept in good order by the caretul examination of the fire heads every three months. They would keep an ordinary fire within a 13-foot circle, and summon help from the city fire department and ring the watchman's fire gong. Fire buckets with water or sand, as required, were provided one for each man.

Over the manager's desk was placed the tell-tale box of an electric fire signal system, where by a glance he could see where help was needed. Over each large sink was a coil of one inch hose.

Ten of the reversible type fire extinguishers (the carbonate of soda and sulphuric acid type of from two to three gallons capacity) were in place; also ten extinquishers of the carbon-tetrchloride type (useful for electrical fires) were over the manager's and foreman's desks. This was the fire-fighting apparatus.

2. CARE OF STOCK. The celluloid stock was received three times a week and placed in a fire-proof vault with a heavy vault door. Here the product was also kept when completed before shipment. The vault was ventilated by a six-inch inlet pipe at the floor, and a six-inch outlet to the outside of the building.

The electric wiring was in iron conduit pipes with switches outside the vault. The electric lights had extra covers of thick glass and wire guards placed high.

3. STORAGE OF SUPPLIES. The supplies were in a fire-proof room with chemicals and all inflammable liquids in safety cans.

4. CARE OF WASTE. At the end of each bench was a fire-proof can to hold cuttings with an inner perforated disk to hold the waste down under water. This disk was attached to the lid by a short chain. All waste was removed from building at 4 p. m. each day.

All delicate machines were covered each evening with covers of rubber cloth to protect against dust from

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sweeping and water from bursting overhead sprinkler.

5. CLEANLINESS. Cleanliness was the rule. The workmen fell in line, as the place was clean and kept clean.

6. INSPECTION. At 8:30 a. m. there was a thorough inspection of side door exits, windows and fire buckets. The manager personally made the rounds.

Radiators were partly covered with loose iron covers to prevent the contact of material and were inspected daily. No rubbish was allowed to accumulate behind the radiators. Fire-proof doors and iron clothes closets were provided. The windows were self-closing.

Each motor was covered with a loose iron cover keeping pieces of stock from contact with the motor. The electric lights over the benches had the usual cone-shaped reflectors. These were covered with wire gauze to prevent material coming in contact with a broken electric globe in case of accident.

Absolutely no smoking was the rule *and the rule was in force.* No matches of any sort could be carried into the building and anyone found with matches was discharged. On hiring new employees it was understood that the manager and assistant would be likely to inspect the clothing in the lockers at uncertain intervals by feeling for matches. Fire must have a cause, so remove the cause.

Difficulties in Employing Women

By L. H. Colburn

General Manager, Colburn Machine Tool Company

THE writer has read your editorial in the January number of INDUSTRIAL MANAGEMENT and it certainly hits the nail on the head. The question of employing women is a most timely one, and one that should be kept before the public until it is settled so that the nation will get the benefit of the work of the vast army of women that are available, but for certain reasons are not used to the extent they should be.

In the writer's opinion, based on recent experience, the principal difficulty in employing women is the attitude of the labor unions. To illustrate: The Colburn Machine Tool Company has a large and splendidly equipped plant located in a small city where the living conditions are of the best. There is plenty of sunshine, good air, beautiful surroundings such as trees, grass and flower beds, in fact everything to make working conditions pleasant. We work eight hours a day, pay time-and-one-half for overtime and double-time for Sunday work.

We pay the highest wages to machinists and other labor, but in spite of this we have been greatly handicapped on account of not being able to get sufficient help. We are now and have been "full up" for about three years with important war business.

We exhausted all our efforts to get additional men; we advertised in the newspapers for hundreds of miles around; we sent employment agents to the large cities; we offered our workmen bonuses for getting additional men—but all to little purpose. Finally, last July we decided to start to employ women in some of the departments of our plant. We had never employed women in the shop before, but made a careful investigation first and went around to plants in other cities where they were employing women successfully and got ideas on the subject.

We decided that we could use about 50 women on our work, putting them on small machines, light bench work, fitting, etc. We made inquiries and found that we could get all the women we wanted, in fact, they welcomed the idea because, for one thing, we resolved from the start that we would pay them just as much as we paid men for the same work.

We made no secret of the fact that we intended to employ women. Rather, we gave the matter all the publicity we could, thinking that this would let it be generally known that we wanted a lot of women. We had many applications and actually engaged a number. Meantime we went ahead and fitted up special quarters for them consisting of dressing, toilet and rest rooms.

Objections from the Men

About that time we commenced to hear rumors of objections on the part of our men employees belonging to the machinists' union, and finally we were notified that a committee representing them wanted to see us. We received the committee and found that they were unalterably opposed to our employing women in the shop in any capacity. They were afraid that the women if once admitted would, after the war, keep the places which they claimed rightfully belonged to men. No amount of arguing would change them in their stand.

We had a strike about two years ago in regard to the eight-hour day, and we finally granted it on a compromise, whereby we gave the eight-hour day and nine-hours pay, but we did not grant a lot of other demands made at the same time. We run an open shop, but about two-thirds of our machinists probably belong to the union. They have given no trouble since the strike, in fact we have not had a committee wait on us for a year and a half until this question of women employees came up.

Rather than have any trouble we gave up the idea of employing women for the present. We put about seven or eight in the tool room and stock room to wait on the window, look after the stock and do various jobs not in these two departments. They do not run any machines except hack saws. This is as far as we have been able to get in employing women in our establishment, notwithstanding the fact that we could still use 50 of them, if the machinists' union did not object.

Objections of the Public

Aside from the objection on the part of the union, we have found that the general public also objects to some extent. Of course, we would not care about this if the union did not object, as we felt that this prejudice would be overcome after the women actually worked a while. However, as it seems impossible to change conditions at present we thought we would start a little educational campaign to mold gradually the sentiment around here in favor of employing women. One of our local papers just put out a special number and wanted us to take space. We decided to take a page. It was a sort of an argument in favor of women working in the manufacturing industries. The illustrations showed some of the largest heavy-duty drill presses built by us being operated by women in manufacture of large shells.

Although these machines are made by us in our plant in Franklin, and are operated by our customers with women employees, we are not allowed to run them except by men. It has been demonstrated many times that women can run such machines as well as the men. It does seem to be a most inconsistent thing, that we are not allowed to operate these machines in our shop, when our customers in many other places are doing so?

If our legislators at Washington were not afraid of the consequences they would take steps to remedy some of these wrongs and not only do justice to all women and men alike, but thereby overcome one of the greatest obstacles in winning the war and that quickly.

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The Employees' Benefit Association—III

What Service Shall It Render? What Benefits Shall It Pay?

By W. L. Chandler

This installment discusses the questions of what kind of medical, hospital and nursing service should be provided, and then turns to the specific problems of benefits for various forms of disability and deaths of members and dependents. The problems presented and answered are from Number 30 to 47, inclusive.

Mr. W. L. Chandler *has had experience in every department of the plant of The Dodge Manufacturing Company. Of late years he has specialized on the study of employees' relations. He has been identified with many local and national movements, was chairman of the Danger Emblem Committee of the National Safety Council, and is now chairman of a committee of the National Association of Purchasing Agents.*

WHAT should a benefit association do for its membership? We have considered various problems pertaining to its organization and management in the two preceding issues of INDUSTRIAL MANAGEMENT. Now we must decide what service shall be rendered to the members, what limits shall be placed upon the benefits, and later on must determine the amounts of daily benefits and the rates of dues required to permit such benefits safely.

PROBLEM NUMBER 30
SHOULD AN ASSOCIATION PROVIDE FREE MEDICAL SERVICE?

This is one of the problems most open to debate, and is receiving a great amount of attention everywhere. It is being approached from both the angle of the association and also from that of the self-interest of employers in maintaining their forces at the highest point of efficiency. Difficulties are met in making satisfactory arrangements with physicians for this service.

Of the associations reporting to the Commissioner of Labor, 20 per cent. and 30 per cent. of those reporting direct to me, maintain free medical service, but detailed costs and plans of operation are not ready for tabulation.

In many cases the function of the association physician appears to be not to render complete medical service, but more to guard against imposition. In some associations, he supplies only first aid treatment in case of accidental injuries. In others he acts through free consultation, but gives no medicine.

Frequent discussions of this subject discloses a general feeling that free medical service for association members, for all employees in fact, is quite desirable. Many feel that such services for wives and dependents of members would be highly beneficial in the direction of eliminating one of the greatest causes through which members or employees, get into the hand of the loan sharks, leading to an harrassed mind, domestic trouble and consequent inefficiency.

The present great doubt relates to the question of management. A difficulty due to malingering, whereby both the physician and member may benefit unjustly, is a big factor to be overcome. Some physicians have been paid a yearly salary of a stated amount per member, but the service has been criticised as indifferent.

With so many experimenting with this question, we shall soon have more definite information for consideration. Medical service of the association need have no relation to any medical supervision of employees on the part of the employer. However, combining these functions offers certain advantages.

Workmen's compensation laws have increased the interest of employers in the selection of the right man for the right place, and in guarding against the placing of men subject to apoplexy, etc., in charge of equipment where they may injure themselves or others, etc.

Labor distrusts the plans for medical supervision on general principles. I suggest, as an educational feature, that the medical inspection of employees be handled through the association physician, the employer contributing toward the expense of the physician to compensate for examinations of new employees, etc., provided the association accomplishes some specified thing as a condition of the employer's help. In this way, the men will be in closer contact with the work of the physician and therefore will see its advantages. (See Dr. Steinmetz's remarks in Problem Number 3, page 35 of the January number.)

The fact that the association physician is largely under the control of members will lead them to realize the benefits which they derive from medical consultations as a preventive of disease. The problem is to guard against any act which would give an opportunity for a disturbed mind to draw the conclusion that the information given to the doctor might be used disadvantageously in some manner, sooner or later.

If men can be brought to see the value to them of medical supervision, they will crave it instead of fearing it as they often do now. Physicians need not make free visits to the homes of members, but free consultations during certain hours at the plant have produced favorable results.

PROBLEM NUMBER 31
SHOULD AN ASSOCIATION PROVIDE A DENTIST?

A few associations now have arrangements whereby the teeth of members are examined frequently and kept in repair constantly. In view of the relation of the teeth to the entire physical system, it would seem wise to consider this point carefully, and if satisfactory arrangements can be made with local dentists, the men can be taught to appreciate the value of such service.

The examination of teeth and instructions for proper home treatment and care will prove a good step in the right direction. In such a plan the members would be referred to a dentist when treatment was needed.

The association dentist would probably secure much of this extra work on his own account if he proved to be popular with the members. In selecting a dentist great care should be exercised to pick a man who will become popular. It is through such popularity that an employer may expect to develop sentiment favorable to his plant and himself.

PROBLEM NUMBER 32
SHOULD AN ASSOCIATION PROVIDE AN OCULIST?

The eyes play a part fully as important as the teeth and often are the cause of many other ailments. Poor

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eyesight no doubt is the cause of frequent accidents endangering the lives of employees.

In view of the advantages arising from having a force of employees of known soundness of body, establishments may well consider the matter of absorbing the entire cost of the free medical, dental and ocular inspections and service as far as it is maintained.

This plan is already in successful operation in a few concerns and covers all employees. In most cases, the practitioners are on duty at the plant only at certain specified times. In many associations, the physicians do not visit the homes, but prescribe for those simpler cases which come to them while they are at the plant.

Problem Number 33

Should an Association Provide a Nurse?

A few establishments have nurses on duty at the plant only, while in other cases the nurses visit the homes, giving advice as to sanitation and allied subjects. This is not a common arrangement, however.

Some consider the services of a nurse as of value as a compromise between no medical service and full medical treatment. It is possible to spend a lot of money on a nurse with small return, just as on a physician or oculist, unless business methods are followed.

Nurses are of two types: One operates with mathematical precision, follows all rules and regulations laid down in the most formidably rigid hospitals, and while she may not provoke any actual ill-feeling of employees toward the establishment, she does not build up any of the good will so essential to the greatest success. The other has a big heart, and through her treatment of the sick and injured may build up relations between the employees and the establishment which will prove of great value when contrary influences develop from other sources from time to time.

Problem Number 34

Should an Association Provide Hospital Treatment?

A few establishments maintain private hospitals, while others have arrangements with nearby public institutions. In these cases, the service seems to be independent of membership in the association, and apparently the associations do not provide for hospital service except as it may be paid for by the beneficiary.

Some employers maintain beds at nearby hospitals for the free use of their employees when in the opinion of the plant physician the employee should have hospital treatment.

Problem Number 35

Should an Association Provide Benefits for Temporary Sickness Disability?

This benefit feature is provided for in 93 per cent. of the associations. Those which do not embrace this benefit are organized to provide death benefits only, except one for permanent disability and superannuation only, and two for superannuation only.

The reports did not distinguish between cases due to accidents and to sickness, but of all associations, comprising about 350,000 members, certain data has been compiled as is shown in Table 2.

Workmen's compensation does not cover disability or death due to sickness and does not cover accident when off duty, so the association may well cover these whenever the compensation act does not. Unquestionably all disability should be covered by some means, and in cases where compensation enters, the by-laws may provide special treatment as covered in Problem Number 36.

Table 2

Average Temporary Disability of 429 Associations and the Employees' Benefit Association of the Dodge Manufacturing Co.

	Experience for one year of 429 associations comprising 350,000 members. Covers both sickness and accidents.	Experience of association at Dodge Manufacturing Co. for 1915		
		Sickness and Accidents combined	Sickness only	Accidents only
Average cost per member for one year for disability benefits.	$3.42	$3.33	$2.74	$ .59
Percentage of all members receiving disability benefits in one year	.21%	.29%	.24%	.5%
Average amount of disability per beneficiary	19.12	11.58	11.42	12.41
Average length of disability per beneficiary	22.2 days	11.2 days	11.0 days	12.2 days
Average length of disability per member	4.7 days	3.31 days	2.64 days	0.58 days

Problem Number 36

Should an Association Provide Benefits for Temporary Accident Disability?

Regardless of workmen's compensation or employers' liability laws, 90 per cent. of all associations pay disability benefits for accidents, much as any accident insurance company would pay its just claims. Of these associations, 22 per cent. are managed at least in part by the establishments.

Some establishments have been reimbursing the associations for disbursements due to accidents to members while on duty in lieu of payments to the injured. The workmen's compensation laws interfere with such arrangements in most states. Some associations do not pay for any accidents for which the establishments are liable under the law.

Of the associations managed by employees alone, 93 per cent. pay these benefits; a very few restrict them to certain definite accidents such as those occurring when on duty, when going to or from work, or in some cases to accidents occurring when not on duty.

Of the associations managed either by establishments alone, or jointly by employees and establishments, 91 per cent. pay temporary disability benefits for accidents.

From the standpoint of temporary disability, workmen's compensation affords no protection against accidents except during work hours in regular occupations which, in some few industries, may be safer than those spent in going to and from work. Only about one-third of the actual hours in a year are covered by compensation. It is said that only about 50 per cent. of accidents disable for two weeks or more, so that in states where two weeks waiting time is required, compensation of itself does not take the place of employees' benefit protection where such benefits begin in less than two weeks.

When compensation awards, say fifty or sixty per cent. of a man's wages for disability due to work accidents, the association may well pay the balance provided the combined income does not exceed, say ninety per cent. of wages.

In this way, benefits received due to the employer paying compensation serve to reduce the cost to the association and help to create reserves and permit di-

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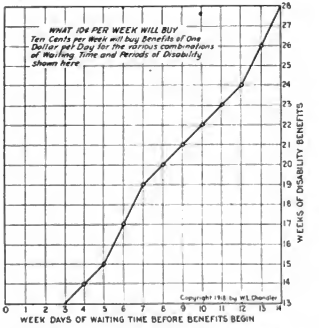
vidends, which will later be shown to be productive of much good.

In the experience for 1915, of the association at the Dodge Manufacturing Co., only about 18 per cent. of the benefits paid went for accidents of all kinds, and of this amount 83 per cent. was paid for work accidents, which formed 81 per cent. of all accidents experienced by members of that association.

Problem Number 37

Should an Association Provide for More Than One Period of Disability?

Of all the associations, 71 per cent. pay temporary disability benefits for sickness or accident during a single specified period varying from 5 to 52 weeks for one disability, or, in many cases, for the total of all disability benefits as a maximum in any year, 13 weeks being the general period.



On the other hand, 23 per cent. of the associations have a secondary period after the expiration of the first one, wherein the benefits are reduced. Adding both periods together, 26 weeks is much the most general total term for these.

The remaining 6 per cent. have three and four periods, some running apparently without constitutional limits.

Of the associations with three or more periods, one-third have no constitutional limits for the last period so long as membership is maintained.

The average disability of all associations for one year was 22.2 days, so that the cases of temporary disability extending beyond 13 weeks, which is the most popular first period limit, are very much in the minority; however, the Dodge experience indicates that cases running over 13 weeks are likely to be cases of permanent disability.

As a selling point, the fact of having a secondary period is a good one, and for the few unfortunates who are afflicted for a long time and consequently are very greatly in need of funds, the secondary period is a tremendous benefit.

The 1915 experience of the Dodge Association showed that their cost that year would have been two cents per week greater for each member if they had paid one dollar per day disability benefit for 26 instead of 13 weeks. Adding 50 per cent. to this for safety, as was done in all other rates, would have increased the dues for disability 30 per cent. or three cents per week, in order to have doubled the period of possible benefits. When we consider that the man who is disabled beyond thirteen weeks is tremendously less fortunate than his more favored brothers, we can appreciate the value of having protection to fall back on for a period as long as can be arranged.

Problem Number 38

Should an Association Provide Benefits for Permanent Disability Due to Sickness?

Only four per cent. of the associations pay benefits of this kind. This showing may possibly be increased by some associations where the by-laws are so written that some unusual case might be decided in favor of a member permanently laid up by some occupational disease, or where loss of an eye is covered and by-laws do not specify that it must be lost by accident. These are very remote possibilities, however, and probably four per cent. is about right. The reports do not distinguish between accidents and sickness, so all figures are combined and given under Problems 36, 39 and 49.

No figures are available at this time, but it appears that of disability due to sickness, permanent disability is of much less frequency than temporary disability, and the experience of the Dodge Association for one year shows that to have extended the period of disability benefits for both sickness and accident to cover six months instead of three would have increased the dues required for temporary disability 30 per cent.

A careful investigation of the cases of disability of the Dodge Association arising in 1915 indicates that any case running more than 13 weeks may well be considered as permanent disability. One member had lumbago and returned to work two days after benefits ceased. He *might* have been sick yet if benefits had continued. Others either died or were still disabled when last heard from. Some cases of tuberculosis, or other diseases, may throw a slightly different light on the matter, but for safety we should look upon cases running over 13 weeks as being permanent, until we can secure more accurate data.

Insurance covering permanent disability is extremely desirable from humane and sociological standpoints.

Problem Number 39

Should an Association Provide Benefits for Permanent Disability Due to Accident?

Twelve per cent. of the associations provide benefits of this nature. A quarter of one per cent. of the membership of these associations received such benefits in a year. The figures given include benefits covering sickness, as well as accidents in four per cent. of the associations, or one-third of those with this provision. The average cost per member for permanent disability for both sickness and accidents was 48 cents, and the average benefit for the year was $194.76 per beneficiary. This is equivalent to $48.60 for 13 weeks or 2½ times the amount per beneficiary for temporary disability.

Disability covering accidents beyond the protection of compensation should, in my opinion, be covered by insurance as soon as rates can be established. Can you imagine a sadder case than that of a man once well and a good provider, laid low by accident or disease so that his loved ones are in actual want while he realizes that if he were only dead rather than disabled, his family would be provided for through life insurance? What a strong temptation toward suicide.

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Problem Number 40

Should an Association Provide Benefits for the Death of Members Due to Sickness?

A provision of this kind is found in 83 per cent. of the associations. In the statistical reports, no distinction is made between sickness and accidents, so the figures include both. These benefits vary from $10 to $2,000. The average death claim paid in one year is $209.76. For the year reported, the average cost per member of such associations for these death benefits was $1.45.

The death rate per 1,000 members was 6.7, being lower than the general death rate of the country, due to the fact that only able bodied persons can gain or retain employment in the industries. This fact contributed toward the differences between death benefits in these associations and straight life insurance.

The mobility of employees, together with their usual improvidence, makes it difficult to provide a form of benefit to remain available after a member has ceased to be employed in the establishment to which the association is attached, except as it may some day be done through a Federation of Benefit Associations.

Of the classes of industries, each represented by 10,000 or more members, the death rates per 1,000 are as follows

Iron and steel rolling mills	6.7
Machinery manufacturers	6.5
Coal mining	5.6
Street railways	8.8
Wholesale and retail stores	5.5

Unquestionably some amount of death or burial benefit should be provided, becausc it can be handled without much additional overhead cost and may be had for 2.5 cents per week for each member (for a benefit of $100 at death) with a fair margin of safety in the rate.

Comparison with the cost of industrial insurance shows this cost to be very favorable, not as a substitute, but as an additional source of benefit.

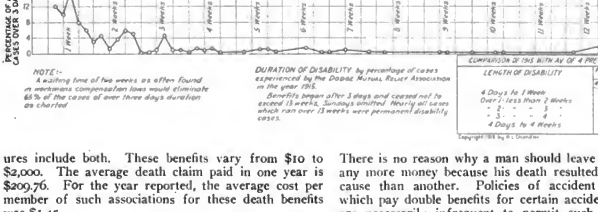
Problem Number 41

Should an Association Provide Benefits for Death of Members Due to Accident?

Data given under Problem Number 40 must be considered here also, as the associations in their reports did not distinguish between deaths due to sickness and those due to accidents. Ninety per cent. of all associations provide death benefits for accidents. Ten per cent. of these apply them only to accidents when on duty. Eighty-three per cent. pay for both sickness and accident.

Death benefits are usually for no more than burial purposes and amount to so little that no distinction should be made between deaths due to sickness and accident, and workmen's compensation awards may well be ignored in awarding death benefits. Deaths due to accidents are apparently much less frequent than those due to sickness.

Burial or death benefits should be paid regardless of whether death was the result of sickness or accident.



There is no reason why a man should leave his family any more money because his death resulted from one cause than another. Policies of accident insurance which pay double benefits for certain accidents, which are necessarily infrequent to permit such payments, take advantage of the human inclination to gamble. There should be more of mutuality in an association.

Problem Number 42

Should an Association Provide Benefits for the Death of Members' Wives?

Twenty-two per cent. of all associations have such a provision. Their annual cost for this service averaged about 25 cents per member. All members paid the same dues. This experience covers 65,889 members, of which 3.7 out of each thousand received such benefits in a year, the average benefit being $63.19.

Local conditions may affect the answer to this question. Labor now pays very high rates for industrial insurance, due to the necessarily high cost of doing such insurance business as it must be done under present plans. The cost of sending a collector to the home each week to collect small premiums is excessive in comparison with a plan whereby the amounts are paid to the association through the payroll along with the sickness and death premium covering the member himself.

It has been estimated that 26,000,000 persons in the United States carry industrial insurance, paying $120,000,000 per year, the average policy being $127. The average premium is about nine cents per week, indicating the reason for the high cost of collection.

It is also interesting to note that the number of persons carrying industrial insurance in the United States was 78 per cent. greater than in Great Britain, but the aggregate amount of insurance premium was practically no greater, indicating in this country either lower rates or smaller policies, or both.

Apparently five cents per week is a safe rate for a $100 benefit for death of wife, provided a reasonable number of the members insure their wives. In fact, I believe this rate can be lowered as soon as some experience is gained to point the way.

The insurance of wife and other dependents can be handled through the association more cheaply than through stock companies, and this has a tendency to attract men to the organization. In some cases, it may help reduce the frequency of the turn-over of men.

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Problem Number 43

Should an Association Provide Benefits for Death or Disability of All Dependents of Members?

Ten per cent. of all the associations pay benefits for the deaths of dependents of members. The average cost for this service, covering other than wives, was about 28 cents for each member of these associations (44,381 persons), of whom six in each thousand received such benefits in a year, the average benefit being $43.46. These benefits range from about $10 for a stillborn child to $25 for the death of an 18-year-old child, $50 for father, mother, brother or sister, and in one case $100 for the death of a daughter in charge of the household of a member who had no wife (or husband).

Apparently no association has covered either temporary or permanent disability of either wives or other dependents. The matter seems like quite a long step now, but if the associations are looked upon as the easiest means of enabling labor to provide against future adversity along the lines of sickness and accident, I believe we shall, in a few years, see this feature embodied under suitable regulation in many of the associations.

As a step in this direction, it seems possible to cover with ample safety, deaths of dependent children over two and under sixteen years of age at the rate of four cents per week for a $50 benefit. The rates may be reduced as experience warrants. This rate is intended for those cases where only the members insuring children pay the dues for such coverage.

The average cost of 28 cents per year given in this problem covers cases where all members pay the same dues. This indicates that two cents per week *for all members* would permit an association to pay safely, say, about, $100 at the death of any dependent (wife, child, mother, etc.), of any member until enough experience was had to determine more scientific rates.

There is considerable question, however, about the willingness of labor to accept this sort of a plan where all members pay the same dues regardless of whether they have dependents or not. That can be best determined by a vote in each case.

Extract from By-Laws of Dodge Manufacturing Company Association

Art. VIII. Sec. 4. Members of this association may each take the various benefits at the corresponding rates of dues, provided that no member shall receive from all sources temporary disability benefits in excess of ninety per cent. of his average wages for the three months preceding disability.

This permits each member to insure his dependents or not, as he chooses. The rates are made high enough to distribute the cost over the members who subscribe for the protection. See Problem Number 17 in the February issue, page 110.

Problem Number 44

Should Temporary Disability Benefits Be Computed by the Day, Week or Month?

Six per cent. of the associations pay by the day; 87 per cent. by the week; one per cent by the month; the remaining six per cent. did not specify. A few do not pay for a fraction of a week. It would appear to make little difference whether payments are computed by day or week, provided fractions of a week or month are prorated, otherwise the question is important.

Regardless of the frequency of the payment of benefits, the unit of measurement should be one day in order to treat all members fairly, and benefits should be paid with the same frequency as the wages of the establishment. Labor is generally accustomed to wages based upon daily rates; consequently, daily benefits paid weekly or less often are usually desirable.

Problem Number 45

How Soon After Joining Should a Member Be Eligible for Disability Benefits?

Of the associations paying temporary disability benefits, 42 per cent. provide that members are eligible as soon as they join the association. It is interesting to see that this provision is found in 88 per cent. of the associations managed by establishments, in 54 per cent. of those managed jointly; and in only 35 per cent. of those managed by employees. Fifty-eight per cent. of the associations require a specified length of membership ranging from one week to 12 months.

Thirty-eight per cent. of the associations having a specified time require membership of either 30 days, 4 weeks or one month; 26 per cent. require either 90 days, 12 weeks or 3 months; 11 per cent. require either 60 days, 8 weeks or 2 months; 10 per cent. require 6 months, while the remaining 15 per cent. are thinly scattered. A few pay at once in case of accident.

The purpose of requiring a period between joining the association and drawing benefits is to prevent employees from joining to draw benefits for a disability due to sickness, which they feel coming on them or to which they have been exposed. A medical inspection and an investigation before acceptance in connection with a period of 30 days' wait, during which new members are not eligible for benefits except for accidents, should prevent loss from disability resulting from diseases contracted before joining.

Problem Number 46

When Should Temporary Disability Benefits Begin?

Of all associations 93 per cent. pay temporary disability benefits. Twelve per cent. of these associatons begin payments from the date of disability without restriction. Thirty-one per cent. pay from the start for disabilities continuing for periods varying from more than two days to more than two weeks. Ten per cent. pay after a waiting period of from one to six days. Thirty-two per cent. do not pay for the first seven days. Four associations require more than seven days, two of them not paying for the first two weeks. Ten per cent. pay from the start of accident disability, a few specifying that it must be an accident while on duty, and they have periods varying from one to fourteen days before payments begin for sickness.

This question of temporary disability benefits has aroused considerable discussion in connection with workmen's compensation laws. The usual purpose of an association is to help the members when they cannot help themselves. If they can help themselves through disability of short duration, say the first three days, the cost of maintaining the association will be vastly less and dues will be correspondingly lower than when benefits cover the first three days. See Chart, page 222.

Several short periods of disability coming close together might be as unfortunate for the member and the association as one of longer duration and consequently should be covered by a provision whereby the total disability in a fixed period of time is taken into account when computing benefits. Extract from By-Laws Dodge Manufacturing Company Association, Art. VIII.

Sec. 19. Any conscientious efforts on the part of disabled members to return to work, which may actually result in relapse, causing two or more short periods of disability instead of one longer one, shall not deprive them of the benefits they would have received, had they remained away from work. They

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shall not, however, be paid benefits for the days on which they work.

Sec. 20. Convalescent members able to work part time, may receive partial benefits in keeping with the facts at the discretion of the directors.

The law recently enacted by Congress covering compensation for employees of the United States Government in cases of accident and occupational diseases includes a provision for three days waiting time. This law has the support of the American Association for Labor Legislation and undoubtedly represents the views of our foremost sociologists. Similar laws in Switzerland and Germany have three days, while England has one week and our former United States law had 15 days.

The Dodge Association has always paid benefits beginning with the fourth day, so that no statistics pertaining to claims for disability for a shorter waiting time are available.

One very bad practice is found occassionally: An association may provide that benefits begin, say, after the first three days, unless the disability extends beyond a specified time, say one or two weeks, when payment is then made for the whole time. This is equivalent to saying that if a member who is disabled for a period approximating the specified amount of time will only stay home a few days longer, the association will not only pay benefits for the extra time off, but will give him a bonus consisting of the benefits covered by the waiting time. For example: a waiting time of four days may be cited; a member sick two days gets nothing, but if he will malinger two days he will receive benefits for all four days. No further comment is necessary.

Problem Number 47

Should an Association Limit the Period or Amount of Benefits for Temporary Disability?

Four per cent. of the associations have no provision in their by-laws to limit the length of time during which a member may receive benefits for temporary disability. Some of these provide for a specified length of time as a maximum for each year, but apparently pay such benefits each year as long as disability continues.

Associations are of three classes: Those limiting the number of weekly benefits in one year; those limiting the benefits to a certain number of weeks for each disability regardless of how many disabilities there may be in a year; and those which limit the amount of benefits both for one disability and for one year. As shown previously, some have as many as four periods for one disability, each succeeding period carrying a smaller benefit than the one before it until the last one sometimes is very small.

Ten per cent. of the associations provide for donations from the treasury to disabled members, or extensions of periods according to the merits of extreme cases. The Dodge Association puts all incomes from merchandise sales, etc., into an emergency fund and loans this out without interest in some cases.

Table 3 shows the various periods and the number of associations in which each method prevails.

With 13 weeks as the most popular period and 22 days as the average disability, the cost of periods longer than 13 weeks is less than their relative lenghts would suggest.

The experience of the Dodge Association during 1915, together with what is known of experience elsewhere, indicates that for three cents additional dues each week, they could pay $1 per day benefits for 26 weeks instead of 13. It is interesting to note that the cost of this extra 13 weeks is the same as the difference in cost of the 10 days between three and 13 days waiting time. See Chart.

TABLE 3. RELATIVE POPULARITY OF THE VARIOUS LIMITS OF TIME DURING WHICH ASSOCIATIONS PAY DISABILITY BENEFITS

Associations having only one period of benefits

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
5	3		6	2	
6	9		8	10	
7	1		10	5	
8	10	4	12	6	
9	1		13	20	40
10	36		14	2	
12	38		15	2	
13	65	65	16	3	
14	2		17	4	
15	12		20	1	
16	5		25	1	
17	6		26	14	16
18	4		28	1	
20	5		39	1	
24	3		52	16	11
25	1				
26	27	11			
33⅓	1				
35	1				
59	1				
Unlimited	6				
Total	237	—	—	88	—

Associations having two periods. Total of both combined

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
7	1		10	1	
9	2		12	1	
10	3		13	4	35
11	1		17	1	
12	2	20	24	1	
13	7		26	3	
14	1		30	1	
15	2		35	1	
16	1		36	1	
17	1		52	2	12
19	1		60	1	
20	4				
24	3				
25	1				
26	31	39			
30	2				
32	1				
35	3				
41	1				
52	8	15			
Unlimited	4				
Total	89	—	—	17	—

Associations having three or more periods. Total of all combined

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
10	2		52	1	
13	2	20	104	2	
21	1				
26	2	10			
27	1				
36	1				
48	1				
52	3	14			
Unlimited	7	33⅓			
3 yrs.	1				
Total	21	—	—	3	—

Before selecting the length of period, careful consideration should be given to all phases of this problem.

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Under New Management—Judging Men

We Need Skilled Mechanics Somewhat, But We Need Foremen and Bosses Who Understand Mechanics Much More

By Charles M. Horton

The degree of success in installing efficiency methods depends upon the judgment used in handling labor—upon the understanding of the labor mind. And proper, intelligent, sympathetic care of the labor mind is hard to get among foremen and minor executives.

Mr. Charles M. Horton, member of the American Society of Mechanical Engineers, was educated in the public schools of New York City and at the University of New Mexico. He served a drafting-room apprenticeship and has had twelve years' experience in designing special machinery. During a part of that period he was in the employ of the Westinghouse Machine Company, and was personal designer to Mr. George Westinghouse in the gas-engine division. As an avocation he has pursued literary work for years, writing for both fiction and technical publications.

A MAN who does one job well will do all jobs well. Of course, the jobs themselves must be of a kind, in that they call for certain fixed capabilities. But even so. A neat toolmaker, for instance, will do a neat job of typewriting, once he gets his hand in. He is that kind of workman—if so be he *is* that kind of workman. Having commonsense, and the trick that goes with it, of reasoning from cause to effect, he will cut to the obvious in his work as surely as he will have his working tools always where he can instantly lay his hands upon them. A man of methodical mind, I believe such a man is called.

At any rate, such a man in an industrial plant is more to be chosen than great riches, because such a man is sharply representative of that which is synonymous with great riches in an industrial plant—efficient production. Nor will such a man ever give trouble. He knows what he knows, and takes a great pride in it; and because his work gives him the opportunity to exercise that which he knows, he will take a great pride in his work and will hold to it quietly and gladly.

Foremen with Judgment

The world of industry is ever on the watch for such men. Industrial heads will inform you that such men are scarce. Such men are not scarce—we are a nation of born skilled mechanics. What is scarce, however, is a type of boss or foreman capable of judging. Executives for the most part get their reports on the labor situation in their respective plants from these middle men, and because these middle men are advanced more often than otherwise to positions of petty authority on qualities best described as "smooth." Their word is very likely to be inefficient—based on error in judgment. That it is so is lamentable—but it is no less so. Indeed, the hell in industry—if there is a hell in industry—is due to this fact. It makes for friction. It makes for friction by reason of the discontent which it engenders in workmen, who themselves, often keen judges of men, are keen judges of the weaknesses frequently found in the men in power immediately above them. So I say the trouble lies not in the scarcity of efficient labor. Rather, it lies in the scarcity of petty bosses and foremen of a type capable of judging correctly on labor matters.

Ralph Waldo Emerson said that every institution is but the lengthened shadow of a single man. Good judges of men are scarce—that is generally accepted. A good judge of men will surround himself with other good judges of men, and his institution will enjoy a maximum of labor efficiency and a minimum of labor difficulties. Find a concern that is always having labor troubles and you will find a concern that needs reorganizing at the top.

Bosses of the "Smooth" Type

Too many men of the other type are occupying positions of authority in the industrial world today. They may be, and frequently are, good judges of work when that work is turned out. But when it comes to judging the man, or men, who turned out the work, they are what is technically known as "flivvers." They won to their present incumbencies, as I have said, on qualities that are best described as "smooth." They are likable—possessed of the thing that makes them acceptable to those above them—have, in a word, a something that makes for success in a social way rather than in an executive way. As a situation it should not be. The qualities that make a man a success in a social way do not always make for his success in an executive way. The contrary is usually true, I should say.

A man given to correct analysis of men and measures is more often than not a man of independent thought and action. He generally is a man impatiently intolerant of sham or buncombe or chicanery, and, because he can detect these as far as he can smell them, he frequently is rather more rugged than smooth in his intercourse with men. Which of itself, and quite obviously on the face of it, checks advancement. Such a man is generally unpopular. Men twist about uneasily under his searching gaze. They judge him to be without diplomacy, do not like him, refuse to elevate him to a position of authority. In this they err. For such a man would make the best kind of petty boss or foreman. He would be coldly fair where fairness was due. Contrarywise, he would be critical where criticism was in order. And because of his knowledge of men and measures he would make few mistakes.

An Incident from the Drawing Room

I once knew a man whom I shall call Mr. Sparrow, because Sparrow was not his name. Sparrow was one vast ingratiating smile—to twist a Dickens phrase—and he was a sort of go-between, a runner, out of the chief engineer's office. That is to say, Sparrow was active between the chief engineer's office and all departments operating under this office. One of these departments was the drafting-room, of course, which was without

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an established head at the time, owing to the fact that the organization was a new one, and matters were in a state of confusion more or less. The drafting-room carried a small corps of draftsmen, and because Sparrow walked with a sort of hitchy gait, the boys early had tacked this nickname upon him.

One Saturday morning, as the draftsmen were bent over their boards trying to get a job cleaned up so they could get away for the afternoon, Sparrow entered the room with his usual crowhop, carrying in both hands some blueprints and sketches. He was smiling, as usual —his superior sort of smile. He stepped over the threshold actively, and, breezing over to one of the drafting-boards, slapped the blueprints and sketches down upon it. Then he gazed around over the men with the air of one about to bestow favors upon undeserving relatives—or something. Presently he gave utterance to some words. Said Sparrow:

"Fellows, we're working tomorrow."

That was all.

It was all he said. Yet instantly every head in the room lifted, and in every eye there was a look of pronounced belligerancy. The organization was one that paid off semi-monthly, and, while it did not pay for overtime it did pay for holidays and days off, and consequently was not an unsatisfactory institution at all to work for. Nor were the men a dissatisfied group of workmen. They had toiled long hours overtime on a number of occasions, and more than once had spent Sunday in the office. So it wasn't the men. Yet that little announcement of Sparrow's whipped them into a feeling of instant rebellion. It was not what he said; it was the way he said it.

For one thing, he was not bestowing a favor upon the draftsmen, although his whole manner and tone of voice indicated that he believed that he was. And yet he himself might not have felt that way about it. He was just a poor judge of humanity. For it brought on trouble later. Not one of the men came to the office the next day, Sunday, and one of the men even failed to appear Monday morning. Tuesday this man presented himself quietly and handed in his notice. Evidently he had feared a wrathful hand and had secured himself against it by getting another position. Nor was that all. By the following Saturday two other men had quit the concern. And all because of a lamentable lack of insight into character on the part of a petty boss. No doubt Sparrow reported to his chief, when the matter was brought up, that draftsmen, good draftsmen, were scarce, and labor troubles were common anyway.

Efficient Labor is Truly Plenty

Labor we have in plenty, and efficient labor we have in plenty also. And there is a deal of satisfaction among the majority of workmen. But the more capable a man is the more quickly will he become offended over errors in judgment concerning himself on the part of his immediate superiors. Nor will such a man remain satisfied for long under a petty boss or foreman whose qualities for holding the job are a ready smile and a neat trick of turning a witticism when greeted by a superior.

Sparrow was the other kind—I am inclined to linger on this element bearing on labor in the industrial world, because of its very great importance, and because also it has not been given serious consideration. Sparrow was not a judge of men. He held his position, as was plainly evident, by reason of an ingratiating manner toward his superiors. The chief unquestionably liked Sparrow. Sparrow himself unquestionably was a success in his own little circle of friends and acquaintances outside the office. No doubt Sparrow was "there" in that poignant way which is sought and accepted as marking a man "eligible" in our narrow social circles. Sparrow could probably tell a good story, if need be, and perhaps could carve a roast or flop off a turkey wing or leg with due skill. But when it came to reading with sure effectiveness the character and whims and foibles of men not of his protracted acquaintance, he was more than a bull in the china department—he was a downright nuisance and a loss to the concern. Yet how could the chief, as Sparrow was the sole medium between the draftsman and the chief—how could the chief know that? Especially if the chief was a poor judge of men, as is not infrequently the case.

Poor Judges of Men

Show me a concern that is always having labor troubles and I will show you a concern that needs reorganizing from the top clear down to the bottom. The workmen themselves may remain. They have nothing to do with the system in vogue in the plant. All they have to do for the returns accruing to them every week in an envelope is to turn out a certain quantity and quality of work. Dissatisfaction may be theirs, or it may not be theirs, depending upon certain things. But of one of these things executives may be assured. If dissatisfaction is theirs it is because of more or less constant friction between themselves and those immediately over them.

This is due to faulty selection of petty bosses. Faulty selection of petty bosses is due to faulty selection of foremen. Faulty selection of foreman is due to faulty selection of superintendents. Faulty selection of superintendents is due to faulty selection of managers. And so on, although this thing today is being remedied through so-called "employment managers." The innovation is wise, if the employment manager has been well selected, as he will be if the manager has been.

Sparrow's Error of Judgment

Let us return for a moment to Sparrow. Had Sparrow put his announcement this way: "Fellows, the chief wants you to work tomorrow," and had said it with a quiet smile; or had he said, "Fellows, it looks pretty much as if we're all slated to work tomorrow," and had said it with a sober countenance; or had he said, announcing it modestly: "I don't like it myself, boys, but the chief is being pushed for this job, and if you could manage to come down in the morning, he would consider it a very great favor to him." I say, if Mr. Sparrow had come into the drawing-room and made his announcement in a fashion following any one of these, the response, I verily believe, would have been favorable, and the gang, to a man, would have been on the job the next day—and no trouble. But no, Mr. Sparrow breezed into the room, slapped the sketches and blueprints down upon the table, and by manner and tone of voice and ill-selected choice of words gave the draftsmen to understand, willy-nilly, that they were to work the next day. He did not understand his men.

Efficiency and Judgment

Which brings me around to the efficiency side of this question. Efficiency is a thing pretty well understood today—that is, the methods for gaining greater efficiency are fairly well understood. Efficiency organizations each have their own pet tricks, and all of them have to do with ways of doing a thing to effect savings in time and material. Most of them fasten their attention upon labor—the human element—and after getting this element well in hand they turn their attention to routes and

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machines and the manifolding of papers. That they realize the importance of skilled labor to effect satisfactory results is obvious.

That nearly all attempt to crowd an organization of workmen through the same gage of sieve is also apparent. That it can't be done, many have learned to their utmost dismay. Workmen cannot be handled successfully in groups, any more than children can be educated successfully in groups. Educators are coming to recognize this great truth, and industrial men of affairs also must come to recognize certain truths—of themselves well-known among the lower strata in industry—in their own game. A man is an individual, a unit, the composite of thousands of ancestors.

Your Way Not His Way

You cannot make an ox saw wood. Not as you yourself would saw it—directly. But this you can do. You can purchase a circular saw; belt it to a treadmill; lead your ox into this; tie him fast to the bar; throw off your clutch. The ox will feel himself slipping, and will begin to mount the endless wheel—and saw your wood for you. But please notice. He will saw your wood in *his* way and not in your way. You understand what your way is. Your way is to throw a length of four-foot stuff into a sawbuck; lay firm hand upon your trusty bucksaw; and fly to it, making motions like a villain on a handcar making his escape from the hero on a locomotive going eighty miles an hour in a five-reel movie. But to get back. The ox is sawing the wood in *his* way.

Pretty much the same thing must be done in this matter of labor. Not that workmen in the mass at all resemble the ox. Merely, I have taken an extreme case to bring out my point. However, the work of labor is frequently that of own brother to the ox. Often it is an endless grind, having neither head nor tail, and so completely devoid of middle.

But to try to make a lefthanded man do a stunt with his right hand which without thought he would do with his left hand, is like trying to change the color of his hair by the simple process of suggestion. It cannot be done. He will listen attentively to your explanations. But when your back is turned he will calmly continue to do the thing as he has always done it, unless he is a fool. And unless he is a fool also, his way of doing it, for him, will be the best and the quickest way. Because—to flash back to my opening paragraphs—we are a nation of born skilled mechanics. That means that inherently we know "how."

American Initiative

I am minded to tell of an incident which will illustrate American initiative. It happened in an American drafting-room. Three men were assigned the job. The job was in a hurry and the work was equally distributed among the three men—an Austrian who had been in the country perhaps two years; a Serbian who had been in the States perhaps a year; and a representative of a long line of ancestors who had done their bit toward making this country what it was—and is—his family had been in America nearly three centuries. The job, as I say, was in a hurry. It consisted of tracing a great many very small drawings, about 9x12 inches in size. The chief scattered the sheets around on the three drawing boards, and told the boys to push the job.

One draftsman, the Austrian, after removing the job he was working on, tacked down one of the rush drawings, made a guess with the shears as to the size of tracing he would require, and presently was tracing. It took him perhaps five minutes to get under way. He paid no attention to the other men.

One of these men, the highly educated Serbian, was engrossed in the work of getting under way also. This man tacked down not one but three of the small drawings, covered the three with a single large piece of tracing cloth, and himself fell to work. The border lines, the pencilling off and inking in, would be taken care of later, as also would those of the job being tackled by the Austrian. Perhaps eight minutes were consumed by this man in getting under way.

But not so the third man—the American of long American lineage. Having observed the methods exercised by his two associates—with somewhat of a sardonic grin on his face—he himself got busy. He first counted the number of drawings which had been apportioned to him to trace. There were ten or twelve of them. Having ascertained the number, he then spread his whole board with a single piece of tracing cloth, laid off in pencil the size of the sheets to be traced, inked in the border lines to a number equal to the number of sheets required. Then he cut them up; laid them aside; tacked down as many of the small drawings as his board would accommodate. After this he covered each with a piece of tracing cloth—already cut to size and with border lines inked—and began, as the second man had done, to trace a whole batch at once. Needless to say, he finished his job far ahead of either of the others. He was able to do this owing to the fact that he had completed all similar jobs connected with the task at once—trimmed all sheets at once, inked all border lines at once, tacked all drawings down at once, traced all drawings at once. When the last drawing was traced the whole job was completed.

American Labor

Labor—American labor—is like that. Where a job requires som initiative, American labor excels. Yet I hear some executive saying that his own labor is mostly foreign and that none of his jobs call for initiative. All right—as far as it goes. His establishment may be overrun with foreigners—and probably is if it is an Eastern shop—but all tasks, no matter how infinitesmal, or how often repeated, day in and day out, require at some time or other in the process some initiative.

Personally, I never shave myself the same way twice, and I have been at it a good many years. The major processes I do indeed repeat—such as honing the razor, lathering my face and raking it down with the tool. But there repetition ends. I do the job sometimes in ten strokes, sometimes in fifteen; sometimes in long strokes, sometimes in a number of short ones. But never in the same way twice. Nor does the most skilled barber shave all his customers in the same way.

Muscle and Mind

So with any task or operation performed through muscle and mind working one with the other—one under the influence of the other. The mind is really the controlling, the guiding, agency, and the mind *will* wander, at times, no matter how engrossing or how mechanical the job. And it is just here where beautiful precision of movement slips. A machinist may pick up a part from his tray, place it in his lathe and chuck it fast, set his tool and start the first cut, all as he has done the thing twenty times before without perceptible variation in his movements one against the other, and on the twenty-first time fall down to such an extent that he will lose the time he has gained. It is purely a case of mind over matter, and mind ever was and ever will be a varying and a variable constituent to be dealt with.

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Organizing a Purchasing Department

Purchasing is Not Gambling in Materials But is An Important Function in Manufacturing

By G. Sumner Small

If purchasing is properly done materials are obtained when they are required, of the exact quality and quantity specified, and at the lowest price. The general methods by which these ends may be achieved are given in this article.

Mr. G. Sumner Small *is a graduate of the Polytechnic Preparatory School and the Polytechnic Institute, Brooklyn, New York. From 1908 to the present time he has served numerous firms as a consulting engineer and efficiency expert, his experience including almost every line of endeavor. He is one of the senior engineers on the staff of C. E. Knoeppel & Company.*

THE conditions of the material market brought about by the war have given industry a new conception of the function of purchasing. Before the war the question of price seemed to play the most important part, but under the new conditions the paramount question is, Can the goods be purchased and delivered by the time they are needed for manufacturing?

While the saying holds good that the first profit in a business is in the purchasing, the attempt to purchase cheaply by beating the market is frequently carried to a point where it approaches speculation or gambling in futurities. Some concerns even go so far as to encourage their purchasing agents to speculate by holding them accountable where a price fell after purchase was made, or because an additional quantity was not purchased before a price rose.

While there are several commodities, of which a good example is coal, which varies in price with the season, and in the purchase of which the purchasing agent is able to take advantage of low prices by stocking up, as a general rule speculation in purchasing materials is equivalent to speculation in wheat or in stocks, and has about the same opportunities for success. The purchasing agent who purchases at a time and in quantities in accordance with the requirements of consumption, and at the lowest quotation at the time of purchase, usually comes out ahead and best serves his concern.

In a recent case a concern lost many thousands of dollars in speculation and seriously embarassed its manufacturing department through a shortage of material, by holding off on necessary purchases because of the belief that war time prices would not hold. The executives refused needed pig iron at $22 per ton and finally covered at $46 per ton; this was but one of many materials in which they gambled on the wrong side of the market.

Functions of a Purchasing Department

The functions of a purchasing department in the order in which the author has found them to be of the greatest importance in producing profits for manufacturers, are as follows:

(a) Obtaining the delivery of materials at the time they are required.
(b) Obtaining materials of the exact quality for the results required.
(c) Purchasing at the lowest possible price.

Examples of Poor Follow Up Methods

One of the best illustrations in the author's experience of the conditions which may arise in a concern due to poor follow up methods in the purchasing department was a small concern manufacturing heat-treating furnaces. The furnaces were constructed almost entirely from purchased castings and parts. The manufacturing consisted largely of assembly work.

An investigation in the assembly department showed an amazing condition. Figuring roughly by weight, there was enough material on hand to construct over one hundred furnaces, but in no case were all the parts on hand that were necessary for the complete manufacture of any one furnace. The assembly department was filled with semi-completed furnaces on which work had been stopped because of lack of parts. The assembly crews had to be continually switched from one job to another as the needed parts came in, were frequently idle and the consequent assembly cost was so great that there was grave doubt as to whether the concern would be able to remain in business. The installation in the purchasing department of a simple, businesslike follow-up system corrected the difficulties and put the concern on an excellent, profit-making basis.

The manufacture of automobiles, especially those manufactured largely by assembling purchased parts, is another good example. The economical manufacture of automobiles is largely dependent on the maintaining of a uniform flow of parts through the plant, of a daily production of a uniform number of cars, and this is largely dependent on purchasing. A car cannot be completed in the assembly department unless every last necessary part is on hand. It is impossible to have the parts flow to the assembly department in the order and quantities in which they are required unless there is a comprehensive system of purchasing which obtains the deliveries of the parts needed, or the material from which the parts are to be made, at the time necessary.

The manufacturer of an excellent, though much derided small car, was forced at one time to ship his cars to dealers, minus hoods, because the hoods were not on hand when required. The plant had a notably excellent planning system, but in this case failed to give proper consideration to the ability of the vendor to live up to his contract. The purchasing agent must guard against the tendency on the part of vendors to accept attractive orders for a specified delivery date, when there is no possibility of their being able to meet their promise.

Obtaining Desired Deliveries

If a purchasing department is to be organized so as to deliver material to the plant at the time at which it is required, the following points must be provided for:

(a) The purchasing department must be supplied with information concerning the material wanted, and the exact date on which delivery is wanted, a sufficient time in advance of the delivery date required to enable them to obtain delivery on that date under the existing market conditions.

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(b) The purchasing department must keep the manufacturing department posted in regard to the length of time in advance of requirements that material must be ordered to obtain the delivery wanted.

(c) Where there is any doubt of the ability of the vendor to deliver the quantity required at the time required, an investigation of the vendor should be made.

(d) The requests for quotations and the purchase orders should be followed up systematically and persistantly until the required goods have been received.

It is evidently unfair for a concern to expect its purchasing agent to obtain the delivery of material in two months' time where the existing delivery time is four months, nor can he be expected to buy at the lowest prices on short time delivery. Where a purchasing agent is forced to insist continually on exceptionally short deliveries, he becomes a pest to vendors. They may have to upset their manufacturing schedules to meet his demands, and if the vendors are crowded with orders he will be the first customer dropped as his business is undesirable.

Planning Purchasing

The purchasing agent should, as a routine matter, deliver to the manufacturing planning department at regular intervals a list showing the existing delivery time required for each of the various classes of material purchased. The manufacturing planning department is then able to arrange to plan its material requirements sufficiently in advance to allow ample purchasing time. If, after this information has been given, the purchasing agent is not given the length of time to purchase as stated on his list, and the goods are not received in time, the blame lies on the manufacturing planning department.

All requisitions on the purchasing department should have on them the date on which the delivery of material must be made. If the time allowed to purchase is not sufficient, the purchasing agent should notify the author of the requisition stating when delivery can be expected.

Reliability of Vendors

Where large contracts are made with vendors, an investigation of the ability of the vendor to meet the deliveries specified should be made. Inquiries among the vendor's customers may show that due to carelessness or inadequate planning methods the vendor is chronically late in his deliveries. In some cases the vendor is willing to be penalized in case he fails to deliver on the dates specified. The law does not allow penalties in contracts but does allow reimbursing for losses sustained. A clause may be inserted in the contract stating that in case of failure to deliver on the date specified the vendor shall pay a certain sum each day until delivery is made, as and for liquidated damages.

In times of good business vendors are seldom willing to submit to penalties and other means must be taken to assure the desired deliveries. The author has seen a manufacturing concern accept a large contract which a later investigation showed the concern was not mechanically equipped to produce and could not be mechanically equipped to produce in the time given.

The only means of protection against such vendors is to make an actual investigation of the plant capacity and organization of the concern in question. The purchasing agent is hardly fitted to make such an investigation and must arrange to have it made either by a competent man from his own concern or by an outside firm of production specialists.

Following Up Orders

The follow-up system might be called the mainspring of the purchasing department, for satisfactory purchasing service from the manufacturing standpoint is almost wholly dependent on it.

A follow-up system may be generally described as a means by which matters to be taken up at certain definite times are automatically brought to the attention of the person concerned at the time specified. The usual machinery for such a system is merely a drawer file indexed by dates. If a matter is to be brought up on a certain date it is filed under that date in this file. Each day the matter contained in the file for the date is taken out and given to those interested. In this way, on the date set the matter is automatically brought to the attenion of those concerned.

The first point to be followed up in purchasing is the obtaining of quotations. When a quotation is written for, a copy of the letter should be filed in the follow-up file by the date by which a reply can be expected. The length of time allowed naturally depends on the distance the letters have to travel, with an allowance for a legitimate time for the concern written to collect the information required and answer the letter. If no reply is received by the follow-up date another letter should be written. In many cases form follow-up letters can be used to advantage.

All purchase orders should specify the dates on which shipment or delivery is required, however, this is often not sufficient in itself to assure delivery on the date stated and concerns take further means to impress the importance of the delivery date on the vendor. An effective means is the inclusion of a clause on the order that the contract is not binding until the order has been acknowledged and the specified delivery date agreed to as part of the contract. Another harsher method is to state that, "We reserve the right to reject all goods not delivered on or before the date specified." These statements are generally printed in red so as to attract the attention of the vendor.

Some concerns have obtained good results by inclosing an extra order copy to be returned as an acknowledgment, or by having an acknowledgment slip attached to the purchase order by perforations. Either of these acknowledgment forms should contain an agreement to the delivery date specified that must be signed.

Establishing Favorable Relations with the Vendor

The purchasing agent will often obtain valuable information in regard to the best method of dealing with vendors from the sales manager of his concern. The methods by which favored customers obtain the best service from his concern will be the best methods for him to adopt in dealing with vendors. The service you obtain depends largely on the moral status you establish. If they learn that when you set a delivery date you mean business you will have little trouble in obtaining service.

The foregoing point is well illustrated by the customers of a certain foundry. One wrote rather truculent letters to which no attention was paid while a mild request from the other brought immediate action. It was explained to me that the truculent one was always in a rush but forgot all about the letter after writing it, and that they would not hear from him again if they delayed the order a month. However, when the mild one wrote it meant that he really needed the goods and they liked to oblige him.

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The success of the mild customer in obtaining what he wanted was due to his adequate methods of planning and following up his purchases. He allowed them a reasonable time for manufacturing and delivering his orders, but if his goods were not delivered on time they invariably heard from him. In the unusual cases in which he requested quick delivery they knew he actually needed the goods quickly and did their best to help him out.

The easiest method of following up orders is to have an extra copy of the order written which can be used for filing in the follow-up file. This copy should have spaces provided on it for making notations of all follow-up letters.

The first matter to be followed up in regard to a purchase order is the receipt of the acknowledgment. If the acknowledgment is not received within a reasonable time a letter requesting an acknowledgment should be written. After receiving a few letters of this sort a vendor will take particular pains to acknowledge your orders promptly.

The next follow-up point is the receipt of the invoice. If you have allowed yourself a margin of safety on your delivery date, that is, if you will not require the goods for say ten days after the delivery date set, and you are dealing with a reliable vendor, you can place your follow-up copy of the order at the date on which you should receive the invoice if the goods have been shipped when promised.

If you will need the goods on the delivery date or are dealing with an unknown or unreliable vendor, the follow-up copy should be filed ahead of the delivery date, and on the follow-up date a letter should be written reminding the vendor of your order and the fact that you will need the goods promptly on the delivery date set.

The purchasing agent will find it advisable to retain in his department two copies of the purchase order and also the purchase requisition. One copy of the order should be filed in the follow-up file, the other copy should be filed by purchase order number and the requisition copy should be filed by the department ordering the goods and sub-filed by class of goods ordered.

Purchasing Goods for Stock

The purchase of goods for stock should be handled somewhat differently than the purchasing of other goods.

By the usual method the stock clerk determines that additional stock goods are needed and orders the goods purchased by sending a requisition to the purchasing agent. The author has found that it is more efficient and requires less clerical labor if the stock records are maintained in the purchasing department.

In this system the stock clerk is taken over by the purchasing department. When stores issues material on a requisition, instead of entering the material given out on the stock cards, it sends the requisitions to the purchasing department where the material is entered on the stock cards by the stock clerk. When the stock clerk finds that more material must be ordered, instead of writing a requisition he merely gives the stock card in question to the purchasing agent, who writes his purchase order from it. This saves the labor of writing requisitions. The constant following up of the purchasing department by stores for needed stock goods is also eliminated as the responsibility for maintaining that stock is shifted to the purchasing department.

The entering of the stock requisitions on the stock cards keeps the purchasing department in constant touch with the quantity of stock on hand, and if there is an unusual run on any stock goods they are aware of it and are able to hurry in their purchases of the goods in question.

For convenience in purchasing, space is provided on the stock cards for entering the full purchase specifications of the material they represent. There is also space at the top of the stock card for entering the names of the vendors from whom the goods may be purchased and their quotations. This saves the purchasing department the work of keeping a separate file containing these data, and gives them a ready record by products showing vendors, prices, specifications, last purchase price, date of purchase, quantity ordered, date ordered, date received and also the quantity of the goods that is being used.

Carrying the Least Stock Necessary for Requirements

As the purchasing department is responsible under the system outlined for maintaining an adequate amount of all stock goods on hand, it becomes its function to determine the minimum amounts of stock goods to be carried, and the amounts that shall be ordered at one time. The definition of the minimum amount of stock to be carried is the lowest amount to which the stock is to be allowed to fall before more goods are ordered. The minimum amount should be a quantity of goods sufficient to last until more goods can be purchased and delivered. This quantity is evidently dependent on the quantity of the goods which are being used in a given time and on the length of time which it takes to purchase more goods.

To set the minimum amount for any item of stock goods the purchasing department determines first the length of time which will be required to puchase the goods and have them delivered. When this has been determined the stock card is referred to and the quantity of goods withdrawn from stock for an equal length of time are determined from the entries on the card. This amount plus an additional amount for a margin of safety in case delivery is slow is set as the minimum amount.

The minimum amount when set is not final and must be changed whenever conditions change. Whenever entries are made on the stock card, the increase or decrease in the use of the material should be noted and, if considerable, the minimum amount to carry should be increased or decreased in proportion. When the time required to purchase certain classes of goods changes, the stock cards for that class of goods should be removed from their files and their minimum amounts should be changed to meet the new conditions.

The amount of any stock item that should be purchased at one time is ordinarily set at a quantity equal to the minimum amount. When this is done the stock on hand and the investment tied up in that stock is reduced to the lowest possible figure. There are, however, times when this procedure is not advisable such as where a decrease in price or a carload shipment can be obtained by a reasonable increase in the amount of the order.

The method of determining when it is necessary to place an order for stock goods is as follows. When the stock clerk enters on the stock card the withdrawal of material and finds that the withdrawal reduces the amount remaining on hand to or below the minimum amount, he withdraws the stock card and passes it to the purchasing agent or his assistant who writes a purchase order for the amount to be ordered. The concern

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ordered from, the amount ordered, the price and the date are entered on the card, and it is returned to the stock clerk. When it is returned to its file a clip signal is attached to it and remains on it until the goods ordered have been received. By this means all stock cards on which there are outstanding purchase orders are distinguished by a flag and can be more readily located.

Purchasing to Exact Specifications

One of the greatest savings that can be made in purchasing is by purchasing to the exact specifications which are the best suited to the intended use to which the material is to be put. The fault of buying material of a far better quality than is necessary for the intended use is frequently met with. On the other hand as great a loss is often sustained by buying materials of too low a quality. This results often in material waste, or in excessive labor cost in working up the material and frequently means dissatisfied customers.

In a silk ribbon mill, what appeared to be an evident saving was made by buying an inferior quality of silk. Investigation showed that the delay to looms and loss of production from the additional breaking of threads with the inferior quality of silk as compared with the better quality amounted to many times the extra cost of the better grade of silk. In addition this meant a better product and more satisfied customers. There were, however, more expensive grades of silk yet which investigation showed it did not pay to use as the additional strength and reduction in thread breakage would not pay the additional cost.

In another case the author made a saving for a brewery by purchasing their coal to specification as to the heat units per pound and the allowable percentage of sulphur. Under the contract as drawn up a bonus was paid for coal better than specifications and rebate was given when the coal fell below specifications. The contract was made with the same company that had previously supplied an extremely poor quality of coal, and was closed at the same price that had been paid for the coal formerly supplied.

For every use there is an exact quality of material which best serves the purpose. To find this quality careful consideration must be given to cost as compared with reduction in waste, saving in manufacturing labor and improvement in durability or appearance of the finished product.

The more modern large plants are usually equipped with laboratories where the exact suitability of the various grades of material for the intended use are determined and purchase specifications drawn up. These laboratories also sample and test all incoming material and determine if it is the quality ordered. The testing of purchased goods for quality is as important as weighing or counting them for you pay for quality as well as quantity.

While the purchasing agent is usually not in a position to start and manage laboratories for the testing of goods, he can at least show the management the importance of such a step and the probable savings to be effected.

A start in the right direction can be made by listing a number of the purchased articles and questioning their quality. As examples, pencils can be purchased from a cent a piece up. Is the quality you use one that gives satisfaction and is it the cheapest that will give satisfaction? Is the quality of paper used in letters and forms consistent with the use to which they are put? An analysis of purchased goods will often prove surprising in showing up useless waste, and will lead to savings.

Reducing the Variety of Goods Purchased

Concerns frequently buy a variety of goods far greater than is necessary to meet all their requirements. This arises sometimes from lack of standardization in the designing of their products and sometimes from allowing each department to order supplies in accordance with particular whims. The results are a very much larger stock than is necessary, the ordering of goods in small quantities at higher prices, and often the turning out of finished products for which it is difficult for the customers to obtain repair parts.

This inefficiency can also be readily shown up by analysis. Compare the types of certain articles used by the various departments. Is there any reason why they should not all use the same type? Analyize any special articles or special sizes or qualities of articles that are purchased. Is there not a standard article that would answer the purpose just as well? Analyze the variety of types, sizes, or qualities of a purchased article. Is there a sound reason why so many kinds are used, or is it just carelessness? An analysis of this sort will repay you many times the effort expended in savings effected.

Buying at Lowest Prices

As has been before stated, the holding off of purchase or the purchase in advance because of the belief that prices are going up or down, is dangerous and closely akin to speculation. There are some keen judges of business conditions who may profit in this way but the average man would do well to leave the speculative side of purchasing strictly alone. However, there are legitimate opportunities for cheap purchasing at quotations below the market prices and the purchasing agent should keep closely in touch with market conditions through the trade papers pertaining to the goods purchased.

The price at which a purchasing agent is able to buy goods is dependent on the current prices at the time of buying and the size of the market from which purchase is made. The more vendors a purchasing agent deals with the more liable he is to be able to purchase at the cheapest price. Except where prices are standard there is one concern selling the article you want which is quoting the lowest price. If that concern is not on your list you will not purchase at the lowest price.

Whenever an advertisement is seen of a concern selling any of the articles you buy, but not on your list it should be added to your list and quotations written for. If they sell goods that you carry in stock, their name should be entered on the stock cards of the articles in question. If they sell goods purchased but not carried in stock, their name should be entered on the vendors card for the articles in question.

The foregoing gives, in brief, the principles on which the author has reorganized many purchasing departments. The giving of the details of systems and forms has been avoided as they seldom apply to any but the particular conditions for which they were designed. Principles are universal and particulars should be carefully designed in accordance with the principles, but made to fit the individual needs of the case in hand.

Measurement of Management

By Frederick C. Coburn

Naval Constructor U. S. N., Manager Naval Aircraft Factory

LET us consider the stockholders viewpoint first. The stockholders are the owners of business. They have invested capital in it and naturally look for a return, and it is by the relation between the

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amount of this return and the amount of capital invested that they judge the management or the efficiency of management. There are many evils arising out of this habit of stockholders, especially when there is a condition of absentee ownership. There is a tendency to run down the plant, to maintain interest and dividend payments, and do certain things in order to support the market value of securities. Stockholders are uneducated as a rule in regard to matters of industrial management and think that whenever wages are raised dividends go down.

It would be well if there was some way to get stockholders to study the balance sheet so as to be sure the plant has been maintained, and to have some way of learning the effect of raising wages, provided the raise is based on a *quid pro quo*.

The Customer's Viewpoint

The customers, or what is the same thing, the public, look at the quality of goods produced in connection with the price: that is, they want quality at a price and at the same time they consider deliveries and service. The matter of service is becoming increasingly important. Intrinsically, so-called service is worthless, for if the company does the job right the amount of service needed should ordinarily be small, but it makes the customers feel good and, although expensive, appears to pay.

The Employees' Viewpoint

The average employee wants first a steady job, so that he may know how much he has coming in each week and can adjust his scale of living to it. Next he wants good wages, that is, as good wages as other people engaged in the same kind of work receive. Next, he wants fair treatment from his employers, and finally he thinks of good working conditions.

The Banker's Viewpoint

The banker is drawn in because he is asked to lend money to the company. Before he makes a loan he wants to see the balance sheet and then his first thought is the relation between the amount of quick assets and the amount of quick liabilities. He then becomes interested in earnings, dividend records, appraised value of the property and depreciation reserves.

Industry has not yet recovered from the banker's idea that the efficiency of industrial management can be judged by the relation between the amount of "non-productive labor expenditure" and the "productive labor expenditure." This method probably arose out of the practice of judging the efficiency of the management of a railroad by the relation between operating expense and earnings. There may be some value in this criterion, but the relation between overhead expense and productive labor has nothing to do with the efficiency of management. Nevertheless the effort to make expense small with reference to the productive labor pay roll has held back the development of organization and proper management as much as any other one thing.

The Creditor's Point of View

After the creditor has considered the company as a credit risk and made a loan, he judges the company by its promptness and regularity of payment.

The Management Expert's Viewpoint

One who is interested in the subject of management and has made a careful analysis of the job, sympathizes with each of the above groups. Some of their criteria may not be good, but on the whole the business is actually judged from all those viewpoints, and the business must be made to look right from all of them.

Assuming that we have the five general functions of management, namely, sales, engineering, production, financial and legal, these criteria may be distributed to show what each function is responsible for: The sales department for deliveries, service, steady work; engineering department for quality, service; production department for maintenance of plant, quality of output, deliveries, steady work, wages, treatment of employees, working conditions; financial department for dividend record, balance sheet, promptness of payment; legal department for attitude toward the public.

With the responsibilities of the sales department this article will not deal. The responsibilities of the engineering department fall without our present consideration. The financial and legal departments likewise are not for us to discuss here.

But the production department is our field and we shall try to show that competent people in supervisory positions, with proper organization, good control and fair knowledge of facts, will do their jobs and form the foundation for the sales, financial and engineering departments and general administration to lean upon.

It is not well to set up any one criterion by which to judge the efficiency of the management of the production department but rather to consider that we have seven criteria. Nearly if not all of these may be lumped together in the general term of *control*. Then the complete control by people who are earnest, thoughtful and doing their job will produce methods of management which will measure up well by any criterion.

A Few Examples

There is a cotton mill in a certain state which violates nearly all these seven criteria. It does maintain plant, quality of output and affords steady work; but in deliveries it is execrable, the wages are abominably low, the subject of treatment of employees is given practically no thought, and the working conditions are by no means satisfactory. Looking at the plant one finds an excessive amount of material in progress, lax methods of time keeping, a piece rate system of payment based on the principle of limiting the earnings of the employees, but at the same time getting the maximum output.

At another textile mill there is really no coördinating head, no central control, the various department foremen run their own departments in their own sweet way. The plant is run down, is unsanitary; and there is no thought given to the development of personnel.

At another plant, a machine shop, the management is excellent from a technical point of view; the plant is fine; they have unusually good sales; and yet realize about one-third the proper production because no one in the firm understands how to keep work moving.

In any one of these cases a central control vested in a manager who is earnest in doing his job, capable and acquainted with what other people in the industrial world are doing would correct these conditions.

Dividend Record No Criterion

The dividend record is no criterion by which to judge shop management, because dividends may be made even though shop management may be abominable. The relation between expense and productive labor is no criterion of management because it puts a premium on inefficient management. The less expensive the plant, the less money spent on supervision, planning of work, provision of suitable equipment and proper tools, the smaller will be the expense; and the poorer the labor and slower in work, the higher will be the labor cost per unit of output. With these conditions obtaining the ratio between expense and labor is small.

The suitability of the plant, its buildings and real estate, its location with respect to the labor market, transportation facilities, material market, etc., are all criteria by which to judge the founders of the business, perhaps, but are wholly useless by which to judge the present operators of the plant.

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Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Standardization of the Causes of Leaving Jobs

By J. D. Hackett

Industrial Counselors, Inc.

IN attempting to reduce labor turnover, the investigator's first impulse is to ascertain why men leave work because success in the undertaking is mainly dependent on this knowledge. Accurate tabulation of the cause of leaving not only indicates definite remedies for turnover but shows conclusively whether men are eligible for re-employment. Since some firms re-hire as much as twenty per cent. of their men the cause of their departure, in the first instance, should be definitely known and put on record, otherwise unsatisfactory men may be taken on again. It should, therefore, be the ambition of every employer to have a statistical compilation as to the cause of leaving in his hands at the end of every month, so that he can discover facts which promote intelligent turnover reduction.

Unfortunately the wisdom of securing this information has not always been recognized and the fault is principally due to undeveloped employment methods. Even where centralized employment offices exist, the subject has not been valued at its true worth. Two things, therefore, seem desirable: A standard list of the causes of leaving; a standard terminology.

Definition of Terms

In the first place it is well to remember that the word "leaving" refers to departure from whatever cause. Those who leave are divided into four major groups: quit, laid off, discharged, strike.

The term "quit" applies to men who leave voluntarily, either because conditions of work or pay are unsatisfactory at the plant or better elsewhere, or for some extraneous reason. In certain firms a distinction is drawn between the above term and "resigned." In one case a man leaves without notice, in the other due notice of intention is given.

Men are usually "laid off," permanently or temporarily as the case may be, because of lack of work or because they are unsuited in some respect through no personal fault or for the sake of discipline. A distinction is sometimes made between men laid off for a determinate or indeterminate period. In the former case men are put on the absent list. With the exception of men who are forced to retire through reaching the age limit, all are eligible for re-employment.

The term "Discharged" indicates only men who have been forced out by the employer "for cause." "Dismissed" is, perhaps, a better term though it is not so commonly used. The remaining group comes under the heading "strike."

The day is rapidly approaching when the employer will demand monthly returns of his shifting labor with full and exact details as to the cause of leaving, which will be considered as important as production sheets are now, but, though many executives know their approximate annual turnover rate, not one in a thousand has the remotest conception of the relative amount of those who quit, those who are laid off and those who are discharged, and the significance which the increase or decrease of those figures indicates.

Summary of 100,000 Causes

In an examination of a hundred thousand causes of the reasons for leaving work, in some of the more representative plants of the country, it was recently found that 74.6 per cent. quit, 12.2 per cent. were laid off and 13.2 per cent. were discharged. The large majority of existing statistics are almost worthless, however, because there is seldom a proper classification and the assigned cause is too vague in many cases. Much, for instance, is left to the imagination when one is told that a man was discharged because he was "unsatisfactory," "unreliable," or "unsuitable," yet these are the typical phrases under which foremen often take shelter. If specific reasons, well known to the foreman at the time, were indicated, indiscriminate discharge would be minimized considerably.

In one firm where explicit directions were given as to the correct method of making returns, the following interpretations were received from the foremen: "No like work," "no good," "service no longer required," "too much money, this fellow," and so on. Under the heading "Quit" men were described as "going away," "Dissatisfied," while many "worked notice" and "resigned." This will be the result as long as the foreman is allowed to choose his own words. The only remedy is the establishment of a standard method for recording the facts and the provision of the machinery whereby they may be obtained.

Another difficulty arises in the case of men from whom no reason for leaving has been obtained. This was found, in a recently investigated case, to amount to over 60 per cent. of the men who quit and 19 per cent. of the men who were discharged. While it is sometimes difficult to obtain the reason when men quit without notice, no such contingency should arise in the case of discharge because a man cannot be discharged without some one being responsible.

Subdivisions of Main Groups

Having divided those who leave into four main groups, further subdivision remains to be considered. It would seem, from an examination of the records of a number of plants, that men who quit may be placed conveniently in three classes.

Quitters (a) Work.
(b) Pay.
(c) Personal reasons.

It is undoubtedly of value to the employer to know the nature of work to which his employees object so strongly that they seek another job. Intrinsically it may be impossible to improve conditions or the cost may be prohibitive. On the other hand the records may show that the turnover cost may be actually less than the cost of improvement. If men leave, as occasionally occurs because of wet floors; drainage, possibly at a trifling expense may remedy the trouble. If a girl "objects to the smell of glue" it will be easier to remove the girl than the smell.

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Many men quit work because they have a better job elsewhere, and the wise employer will seek to ascertain in what respect his work is inferior. Other men will consider their work too hard or too monotonous; they will object to part time, short time, delays in getting material, night work or continuous Sunday work; they may consider the work dangerous and the risk involved too much for a family man; they dislike excessive dust, heat or fumes; they insist on warmth, good drinking water, modern sanitation and so on. All of these, which are the most usual, should be carefully classified under the main heading "Quit Work."

Frequently men quit because their pay is too small or, conversely, because it is better elsewhere. Another objection is against docking or fines. Some quit because there is no extra reward for overtime, no prospect of an increase, because pay is reduced or the system of paying is faulty.

Progressive employers find it advantageous to know how many of their men leave on account of pay, particularly if the number shows a gradual monthly increase. Whether a man thinks he is getting too little or believes he can get more elsewhere matters but slightly; the circumstance indicates that the employer should consider the revision of his pay schedule and thus avoid a strike.

Personal Reasons for Quitting

Of the personal reasons for quitting work there is no end. One foreman, on being asked to make a tabulation, said if there were a thousand men leaving they would have a thousand different excuses for the move. This is largely true, but many of the differences are merely verbal and unessential. If a man complains he must leave because the work hurts his back he may be properly described as physically unsuitable unless the fault is with the work and not with the man. That men "move away" is hardly precise enough to be of value and is unimportant unless it has something to do with the plant. It is an entirely different matter if housing conditions make it necessary for a man to change his employment. A large loss of employees on this account may force the employer to consider a proper housing scheme in order to stabilize his working force.

Just now a considerable number of men leave work to join the army, navy or some other branch of the service. All of these may be classed under "Government service." Illness in one form or another was frequently found on the records of the plants investigated. Some firms very properly draw a distinction between occupational disease and sickness not directly due to work, also between accidents happening inside and outside the plant. Men who leave on account of accident or illness outside the plant are classified in the quits, otherwise they are laid off.

The natural ambition of every employer is to lay off as few of his men as possible through lack of work. The immediate gain through dropping men may be more than neutralized in the cost of hiring and training others to take their places when work picks up. The number of men laid off should be as small as possible. It is an evidence of good planning. Seasonal work in some plants causes considerable lay-offs but this has been minimized greatly by good management.

Men who are temporarily deprived of work by way of discipline are placed in the laid-off column and the exact cause, in each case, should be recorded. This is a convenient place to put such cases as those in which men are found unsuitable through faulty employment methods or because they do not quite fit in with the scheme of things. If men have "trouble with the foreman" or anyone else the matter should be defined.

Classification of Discharge

The classification of discharged men may be arranged in two groups.

Discharged (a) Work.
(b) Personal character.

It is not always easy to decide whether the effect of work on the character, or character on the work, is the determining factor, but a personal knowledge of the circumstances usually decides the point.

The reasons for discharge as regards work are numerous but can be roughly grouped under a convenient number of headings. It is not advisable to have a separate heading for such closely allied terms as, careless, indifferent, neglectful and the like, any more than for men who are lazy, unwilling or loafers. So long as there are no standards to go by men will be discharged for a number of slightly different reasons which might better be grouped. For instance, unsteady and inattentive men may be put together in one group, while incompetent and incapable men may be placed in another. General terms, however, should be avoided.

Classification of reasons for discharge due to personal characteristics is not difficult. Under one group may be included those who are quarrelsome, fighting or merely disagreeable and men who "can't get along"; under another the grafter, borrower and the "dead beat"; so with the drinker whether he is described as intemperate, unsteady or a booze fighter. Dishonest men, pilferers and thieves should be classed together, as should the insubordinate and disobedient.

Temporary Absences

In some places men are granted what is known as an "accommodation discharge" which, in fact, is not a discharge at all. It is merely a subterfuge to enable a man to get his money in a hurry and in a few days, as a rule, he is back at his work again. This is only a case of temporary absence. In this connection there is sometimes a difficulty in differentiating between those who quit and those who are temporarily away. For the sake of getting immediate statistics it is well to assume that all men have quit unless the reason for the absence is known. This has a good effect in minimizing absence without permission.

How Do You Check Up Employees Who Leave?

Mr. Royal Parkinson, Employment and Employees' Service Manager, American Optical Company, Southbridge, Massachusetts, states one of his payroll problems in the following letter:

"Where can we find assistance on a payroll problem? In particular what means do large concerns have of knowing immediately when workers leave them without saying so?

"With us a large percentage of our losses occur in this manner, and the situation created is a hindrance to the application of our policy of interviewing all leavers. These leavers obtain their final pay by calling for it among the invalid and idle after a week's absence. One method that has been suggested is a visit to the homes of all those who absent themselves more than one day to determine the cause of the absence. I am under the impression, however, that in some firms a system of pay checks controls this situation."

Readers of Industrial Management are invited to send in for publication a description of the means they use in overcoming this employment difficulty and assist Mr. Parkinson and other employment managers.

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Taking Stock of Ideals; A War Measure

By Mary B. Gilson

Employment and Service Superintendent, The Clothcraft Shops

JUST as it is necessary to take stock of materials both raw and manufactured so is it of equal importance for business men and women to take stock of ideals and practices. Often the daily routine swings us from detail to detail with such continuity that we find ourselves acting according to tradition and precedent without sufficient attention to underlying reasons. "Writing is recording, not living," said Mr. Britling, and yet he found stock-taking an inseparable function of life itself. Whether we define the aims and purposes of our daily job in writing or not, it is necessary to define them mentally, to achieve action.

Stock phrases are frequently by-products of stock taking. So "The four walls of the home" became objectionably trite when women awakened in increasing numbers to the broad ramifications of these four walls. "Making men, not materials alone" similarly evidences the results of stock taking; results which prove that industry is awakening to the many ramifications of the "four walls of the factory." In increasing numbers industrial managers are recognizing the connection between what goes on in their establishments and the very life of the community itself.

Making Men For Community Well Being

Perhaps no member of a business organization has more direct duties in connection with man making and consequently with community well being than the employment manager. It is from him that the worker must get a clear idea of his responsibilities toward the organization and the organization's responsibilities toward him. It is his duty to see that the worker gives and receives a square deal. Most important of all, the employment manager with any breadth of vision recognizes what an integral factor he may be in reducing antagonism between employer and employee and in establishing honesty in the relationships of man with man.

The Employment Manager Must Be Honest

The employment manager who is careless in the employment of minors is dangerously undermining the respect of the worker for law, as well as nullifying any good his organization may be doing for the improvement and development of the workers. No young girl or boy who is carelessly admitted to an organization without sufficient investigation of his or her age can possibly have any deep lying respect for that organization. No matter how ignorant and immature a girl may be she is aware of the fact that the man who employed her illegally is being guided by the need of the hour and not by honest motives. And this results in a very natural distrust of business and business ethics. No factory inspectors, no truant officers, no school laws however well enforced, can possibly be effective without the honest and unending support of the man who "hires and fires." And he must ever keep in mind not only that it is a sense of personal honesty which must inspire him but also that he is playing a most important part in breeding honest workmen by not permitting himself to "play crooked."

The Employment Manager Must Not Misrepresent

Luring people from job to job is another crime against the community. It is not necessary to enumerate to the readers of Industrial Management the evils of drifting and the gradual manufacture of unemployables by subjecting them to recurring periods of unemployment "between jobs." Yet, how many employment managers who do not take stock are guilty of advertisements which misrepresent, or of recklessly and selfishly offering a job to a man who already holds a better one? It takes only one or two such experiences to plant a very definite growth of antagonism against "capital" in the breast of the average worker, for to him "capital" comprises the man higher up, and his feelings are due entirely to his cumulative experiences in the working world. "Don't bother to give notice to your present boss. We need you tomorrow morning and can't use you if you don't come then," is the advice of the employment manager who never has time to take stock. Later he wonders why workers are so "mean and irresponsible as to get up and leave their good jobs without giving him so much as a hint."

But encouraging an applicant to be on the level with the concern which he has not yet left is not the whole story. It is equally important to define clearly and lucidly the earning opportunity and the chance for advancement of the man who is considering the job you hold out. Business ethics are still very shadowy on this score. Anyone with imagination cannot help feeling a good deal of sympathy for the young person who goes with high hopes in search of a job only to be met with flowery generalities and no definite and specific information. Business organizations as a whole are still in the infantile stage when it comes to a clearly mapped out scheme of promotion and an efficiently conducted system of instruction. All who have had experience in hiring know how much the success of a worker depends upon opportunity for advancement and the definite pointing out of steps. Here is the occasion for unqualified frankness and honesty. Applicants justly complain of leaving their last jobs because they "made no headway and no one told them why they didn't." Candidly, I think this is frequently due to our negligence and to our *laissez-faire* methods.

Remove the Bitterness at Leaving

Always keeping in mind the responsibility of everyone conscious of modern sociological conditions to do his bit toward eradicating antagonism in the world of industry it is absolutely necessitous for the employment manager to see that the "final parting" is as free from bitterness as possible. This does not mean that it is wise to smooth over issues to the point of beclouding them, but, when every attempt to develop a worker has failed, it is at least worth while to know that he has left with no bitterness or feeling of unfairness in his soul and that for the sake of his future success he understands definitely and clearly wherein he failed.

It is the policy of the management of our organization that we superintendents and foremen are wholly responsible for "getting across" and leaving right impressions and it is a wise policy. The basis of this policy is the saying that "To bear conviction, be convinced yourself." The man who is not basically honest and who is not convinced heart and soul of the rightness of his argument cannot convince the stupidest of men.

"Get Across" Economic Truth

As the war goes on we shall find it more and more necessary to take stock of our business ethics; our standards of morality will have to be more and more closely defined. Russia is today facing problems of national import but these national problems have evolved from individual ones.

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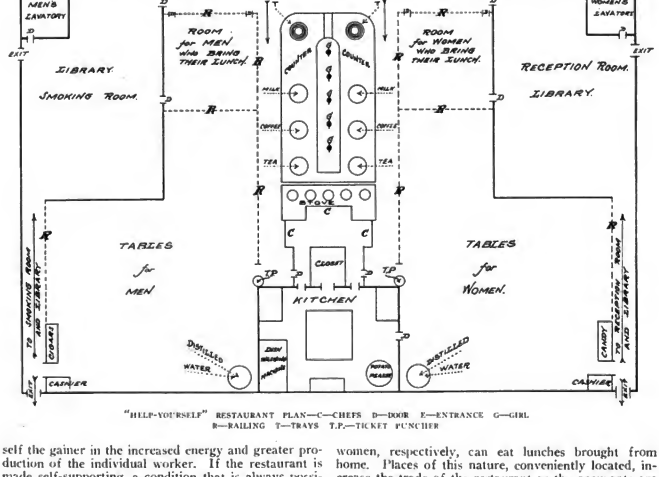
Factory Employees' Restaurant

By C. S. Rossy

Employment Manager, Norwalk Tire and Rubber Company

A RESTAURANT for factory employees always proves to be a profitable investment when properly managed. The employee receives wholesome food at a reasonable price, the employer finds himself the gainer in the increased energy and greater production of the individual worker. If the restaurant is made self-supporting, a condition that is always possible, the initial expense involved in its installation is negligible and eventually becomes entirely cancelled; the restaurant becomes both directly and indirectly a source of revenue.



"HELP-YOURSELF" RESTAURANT PLAN—C—CHEFS D—DOOR E—ENTRANCE G—GIRL R—RAILING T—TRAYS T.P.—TICKET PUNCHER

Why have so many factory restaurants been failures? The reason, in the majority of cases, is the lack of an efficient working plan. Realizing this, I wish to present a brief outline of a "help yourself" restaurant plan which has brought success. Its time saving quality renders it especially valuable when a large number of people must be served quickly.

The accompanying diagram shows the plan. There are two entrances *E*. The employees walk in line by the counter in the direction of the arrows, each picking up a tray *T*, and selecting such food as he may desire. On the counter may be found bread and butter, crackers, pies, sandwiches, cold meats, etc., all of which are arranged on plates before the restaurant is opened. The duty of the counter-girls is to keep a sufficient amount of food available, and to furnish the employees with such beverages as they may desire—tea, coffee, milk, buttermilk, etc. The chefs *C*, at the stoves, serve hot food—soups, beans, vegetables, meats, etc.

Having put his selection on the tray, the employee passes into the dining-room at the entrance to which stands the ticket-puncher *TP*, usually a girl. She notes the contents of the tray, punches a ticket indicating the cost of the food, and gives it to the employee, who then sits at a table to eat. At the conclusion of the meal, the employee as he leaves the dining-room pays to the cashier the amount marked on the check.

It is advisable to have two rooms to which men and women, respectively, can eat lunches brought from home. Places of this nature, conveniently located, increase the trade of the restaurant as the occupants are often stimulated to purchase more food. It is also desirable to have a resting room for women and a smoking room for men near the restaurant.

On the walls should be posted the menu for the day with the price of every item. It is advantageous to distribute printed menus as the employees go out in the evening, in order that they may know what is going to be served in the restaurant the next day.

The following menu is representative of food that may be served at a factory restaurant:

Vegetable soup	$0.05
Tomato soup	.05
Smoked pork tenderloin	.15
Roast veal	.18
Ham and beans	.15
French roast	.15
Mashed potatoes	.05
Pies, cakes	.05
Tea, coffee, milk	.05

The initial cost of establishing a factory restaurant, and the actual expense involved in maintaining it, will, of course, vary with circumstances. The following figures were obtained by the writer from the records of a restaurant patterned after the one described, and now

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being operated by a factory employing about 2400 hands. There is a daily average of 700 patrons. The total monthly running cost is from $1200 to $1300; the total monthly income is about $1400. The initial cost for quarters, machinery, and all conveniences such as tables, chairs, china, cutlery, etc., was about $4000.

The staff necessary to conduct this restaurant is:

	Weekly Wages
One chef	$20
One assistant	14
One dishwasher	10
One porter	12
Three counter girls	8 (each)

Two extra girls, two hours per day at 10 cents per hour.

The more important machinery includes: One 10-foot gas range, one dish-washing machine, one potato-peeling machine, one bread-cutting machine, one meat-cutting machine.

Such a restaurant can serve at least 400 persons in five minutes.

Assisting Employees With the Army Questionnaire

ONE of the outstanding features of the war has been the enthusiastic coöperation of citizens and corporations in the performance of extra duties thrust upon them. Many of these have gone far beyond the requirements and assumed other duties in an endeavor to aid the Government.

The officials of the Westinghouse Electric & Manufacturing Company realized that after the new selective draft regulations went into effect, when all previous exemptions were automatically revoked and the registrants required to answer questionnaires, there was likely to be confusion among its employees as to just what course they should pursue, particularly in the case of those of foreign birth. The company employees in the Pittsburgh district number in the neighborhood of 35,000 people.

Frequent meetings of the officials and superintendents of the company were held to outline the plan for aid and insure the familiarity of those responsible for its execution with the draft regulations. Each superintendent then made up a list of men is his department subject to draft, checking those whose services were considered to be absolutely indispensable, and detailed a man to see that all registrants were properly classified within the time limit.

The company then sent a letter to each local board where any employees were registered, setting forth at some length the nature of its operations and how intimately its work was related to governmental activities, and how dependent it was upon skilled labor. The letter also stated that each case on which the company asked exemption would have been carefully considered and passed upon by the officials best qualified to know. In this way, the board was relieved of a lot of work in answering questions and had the assurance of responsible parties that the exemptions asked for were justified.

After the plan had been carefully outlined to those responsible for its execution, a set of rooms was set apart for the actual work of handling the registrants and their questionnaires. When it is realized that approximately 5,000 men were to be examined, and the short time allowed for its execution, the size of the undertaking can be appreciated.

As a large number of employees of foreign birth are unfamiliar with the English language 15 interpreters, capable of speaking almost any language or dialect in the civilized world, were secured and instructed in the provisions of the selective service regulations.

As each registrant received his questionnaire, he was sent to await his turn, as shown in Figure 1.

The registrant was given a card and assigned to one of the desks numbered from 1 to 15, see Figure 2. At each was located an interpreter to assist in answering the questions when such service was required. When the questions were all answered the registrant left the room by another door, and if the company had selected him for exemption, the questionnaire was retained by the clerk, sent to the superintendent of his section and then to the vice-president of the company for their supporting affidavits. After these are secured, it is returned

FIG. 1. AWAITING THEIR TURN TO ANSWER THE SELECTIVE QUESTIONNAIRE

for filing with the local board. If he was not considered absolutely essential by the company he was allowed to retain his questionnaire and return it to the local board himself.

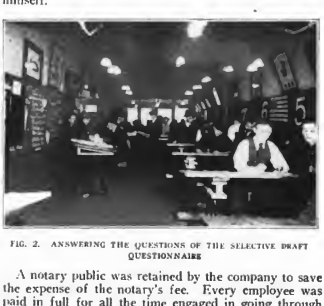

FIG. 2. ANSWERING THE QUESTIONS OF THE SELECTIVE DRAFT QUESTIONNAIRE

A notary public was retained by the company to save the expense of the notary's fee. Every employee was paid in full for all the time engaged in going through the process of completing the questionnaire.

The time required to take care of a registrant varied according to his intelligence and familiarity with the English language; some required only a few minutes, others considerably longer. The average time was about an hour per man.

As an evidence of the advantage accruing to the local boards from an arrangement such as outlined above, a Pittsburg board member said that only about 30 per cent. of the questionnaires turned in individually were correct, while under this plan practically all were right.

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Editorials and Comment

Just Ahead

IS there to be a shortage of industrial employment in the Spring or early Summer?

The work of non-essential industry is slowing down. By "non-essential" is meant the manufacture of articles not needed for the prosecution of war, nor required for the essential welfare of our civilian population. Examples are: Jewelry, luxurious motor cars, silks, laces, pianos and perhaps talking machines.

If this process of slowing down industries of this kind continues we shall have a considerable portion of our labor turned out of its usual employment.

During the past month both the daily papers and the weekly reviews have begun to say that there is danger of a production of war material this year far greater than can possibly be shipped. This situation was commented upon in these columns in our February issue. If this process continues to such an extent that there becomes a congestion of war material in this country that cannot be sent to France, then workers on munitions and war supplies will have to be turned out of that kind of employment. There is one industry that can absorb perhaps 250,000 of them—shipbuilding. But to what work must the others turn?

The problems of transportation have never been brought to our people with more force than since the beginning of this year. Never before have we seen the holding back of industry in order that our railway lines might be cleared of accumulated freight. Never before have the difficulties of railroad operation in blizzards and zero weather been appreciated by those who are not railroad men or members of their families. Never before have we appreciated that the well-being, comfort and even life of our people rest upon the regular movement of freight over our great railway lines.

All of these experiences have shown us that we need more railroad equipment, locomotives, cars, terminals, dock facilities and the like.

The concentrating of industrial workers at new points of industry have brought to the forefront the problem of housing. Briefly stated we should have at once several hundred thousand more houses to shelter our working people.

The problem of handling freight has brought again to the fore the need of developing our canals and rivers as a part of the great transportation system of the country.

The shortage of coal for industrial uses has made more urgent than ever the need of haste in developing water-power projects to supply energy for the wheels of industry.

The shortening of our supplies of food, with the prospect of a tremendous demand upon us during the rest of the war and for a few years after the struggle ceases means that we must utilize more tillable land and turn our attention to reclaiming vast tracts which can be brought under cultivation.

That is, in addition to prosecuting the war we must constructively turn our attention to the up-building of railroad equipment, the housing of working people, the developing of our canals and rivers as a part of our transportation system, the utilization of water-power now running to waste, and the reclaiming of land for agriculture.

If in the Spring or early Summer thousands of industrial workers may be forced out of non-essential industries and even out of war industry, why should they not be put at work on some of these great national needs?

The improvement of our rivers, the digging of canals, the developing of our water-powers and the reclaiming of land have always been either entirely or to a great extent under government direction. Our railroads are now government operated and will continue to be so managed for the duration of the war and for eighteen months thereafter. In connection with war industries the government is making a careful study of housing and even supplying funds to solve the difficulties in certain centers where those industries predominate.

So no one can claim that these national needs should not be met by government action.

Is not the path of wisdom to adopt at once a policy to supply by the government much of the employment that our working people will need to earn their living when a stopping of the present lines of industry comes, either because of internal conditions or through the ending of the war?

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Manufacturers' Associations

WE are beginning to see a new form of manufacturers' organization. About the middle of last summer the leather producing firms of the country united to assist in carrying on their industry during the period of war. The name adopted for the association was The Tanners' Council. Offices were opened in Washington with the president of the organization as general manager and a competent staff was gathered together.

Within the past few weeks the hardware interests have begun the formation of what is known as the Hardware Manufacturers' Association for War Service. At about the same time the founders also united in an organization for war work. The Tanners' Council, dealing with an industry tremendously affected by war conditions, has endeavored to inventory all of the raw material in this country for the production of leather, has been active in distributing orders between various plants, has assisted the government in obtaining deliveries, has aided in the preparing of reasonable specifications, and has been a medium for the bringing together of the various purchasing agencies of the government so that one would not gain control of all the material of a certain kind and grade to the exclusion of the needs of another. It has also assisted in the determination of prices.

The Hardware Manufacturers' organization presented in chart form shows a large number of divisions spread over the manufacturing of hardware, tools and general supplies made of metal, with an advisory price board and section committee heading each group or division. From a study of the literature put out by this organization the impression is given that at least one of the major ideas behind its founding is business conditions after the war. It seems reasonable to think that the organization found by the founders of the country has similar objects.

It is in order to say two things in this connection: The operation of the Sherman law has perhaps been suspended during war conditions but not as yet for the forthcoming days of peace. Too many manufacturers today are devoting themselves heart and soul to the making of profits, and only incidentally are helping to win the war as a sort of side issue.

Factory Gardens

A YEAR ago we were just entering the war. The increasing of our food supply was brought home to us as a popular war measure. The season was so well advanced that what was done to encourage factory gardening had to be done quickly. As might be expected all sorts of results were achieved.

Here and there were factories that handled the matter well, so that their employees raised a great deal of food, at the same time gaining in health, well being and furthering the development of the spirit of the organization of which they were a part. Here and there haphazard, ineffectual efforts brought little that was tangible. But the need for food during 1918 is going to be far greater than it was during 1917. Where one shop garden was essential last year perhaps five must be planted this. The difficulty of getting one or another common article for the home table, and the prevailing high prices, are all the proof that is needed to stimulate present gardening projects.

Two articles in this issue show satisfactory methods for factory gardening in two representative machine-tool plants of New England. In one case the workmen bought their own seed, paid for or rented their tools, and did all the work on their gardens. The land only was supplied, plowed and ready for cultivation.

The other plan was coöperative throughout, being managed by a so-called syndicate in which the employees bought shares.

In each case there was a satisfactory return for the labor and time expended, and plans are well under way to repeat the work this year. The example is well worth following.

And it must not be overlooked or minimized that the increase in the spirit of the organization is one of the best of the results of factory gardening.

Revivification in Industry

ON every side we are being told that the old days—good or bad—are gone never to return. It is being said that industry will be different, and employer and employee will emerge from this war each with a new viewpoint. But most that is being said and written appliés only to material changes, to reconstruction or rehabilitation. These outgivings do not take into account the effect of the self-denial and sacrifice that men and women in American industry are giving as a part of their contribution to the preservation of this nation. Will there not come a revivification in industry as well as reconstruction and rehabilitation? A reader of INDUSTRIAL MANAGEMENT believes this and writes as one who is looking into the future.

"But the reconstruction period will be also a time of revivification! I seem to see more of coöperation and less of competition. I seem to see less of tense striving and more of stopping and looking about and enjoying of things as they are and always have been. I seem to

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see put in practice a bit of admirable advice which I once read somewhere to the effect that, 'As we journey through life let us live by the way.' I seem to see an earnest desire on the part of employers of labor to want their workmen to 'live by the way.' I seem to see less of grasping and more of giving.

"I seem to see Christ the Teacher returning into His Own. I seem to see the humanities more actively recognized and the sciences, as such, less seriously taken. I seem to see the spirit of friendliness and love, fellowship and brotherhood rise out of the dead ashes of this conflict, like a Phœnix, and flutter glad wings above a strained, drawn, haggard, muscle-bound, tired and soul-spent people—all kinds, all races, all creeds.

"I seem to see old enmities buried and new friendships made. I seem to see the seller voluntarily give the advantage, if there be any, to the buyer. I seem to see a rekindling of idealism, as it once was and so must be again, because life is a circle, and we are life. I seem to see honor and probity, charity and rigneteousness so common as to be beyond exaltation. I seem to see the power of money go down, and the things which it represents go the way of all other material things.

"I seem to see you and me, and our neighbor and our neighbor's neighbor, as one, a unit of life recognized as such, going shoulder to shoulder and elbow to elbow gladly along the way of peace, helpfulness and understanding to a goal the like of which never before was known in the history of the world.

"I seem to see all things in the days following the war—the days not only of reconstruction but revivification. God is Infinite in His Wisdom."

Standards of Unbalance

TO know in an engineering sense we must measure. To evaluate the results of a manufacturing process we must count or weigh or gage, or in some way set what has been accomplished over against some previously established standard.

With the increase in the application of the process of dynamic balance of machine parts comes the need of measuring the degree of the results obtained, and the setting up of permissible limits to show successful practice. Now it is possible to weigh the amount of unbalance of a part that should be in either static or dynamic balance. The unit for static unbalance suggested by Mr. N. W. Akimoff is the *ounce-inch;* similarly the unit for dynamic unbalance is the *ounce—(inch)*^{2}. The limits suggested for commercial balancing on the ordinary run of high-speed machine parts are: For static unbalance not more than 0.4 ounce-inches; for dynamic unbalance not more than 12 ounce-(inches)^2.

Some such units and limits deserve to be widely adopted.

For nearly a year we have constantly seen efforts to recruit shipyard labor. Now the Shipping Board is taking a hand with the purpose of enrolling 250,000 men to be taken into the shipyards as needed.

What is the cause or reason for all these efforts? Surely there must be something deeper than the mere need of mechanics to build ships? The article on page 210 gives us the clue, when Mr. Kelly says that if excessive labor turnover in our shipyards is not checked it will be impossible to draw sufficient mechanics even from other industries to carry on the shipping program.

So the kernel of the trouble is that old industrial enemy "labor turnover."

Once he is recognized, steps can be taken to break down his destructive influence. And the article goes on to present some of the best methods that have already been adopted in leading yards.

Incidentally these same methods deserve to be studied by the managers of plants in other lines of industry, provided their labor turnover is not as low as it should be.

A reader of INDUSTRIAL MANAGEMENT has pointed out that we should not lose through the draft the men who are best fitted to teach in our trade and vocational schools, as they will be needed a little later to prepare unskilled men and women for industrial pursuits. He suggests that this viewpoint should be impressed upon the Federal Board for Vocational Education in Washington, in order that their influence may be thrown on the side of preventing a possible evil.

The difficulty of educating without an adequate teaching force cannot be appreciated by anyone who has not actually taught. The difficulties of training our army now in the cantonments is not understood except by those who have it in charge. England's situation in training her huge volunteer armies after she had lost her expeditionary force following the retreat from Mons was enough to stagger the force of will of even the strongest British statesmen.

In degree, of course, the training of the men and women who will come into our industry before very long is simpler than that of preparing a fighting army, but nevertheless it is of the utmost importance. Most thorough and careful consideration should be given to the claims of those that ask exemption on the grounds that they are engaged in teaching in our trade and vocational schools, and are thus in position to do excellent service in preparing the forthcoming industrial army for its duties.

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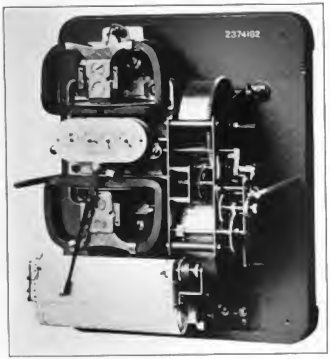
Factory Equipment News

The Latest Labor-Saving Machinery

Recording-Demand Watthour Meter

IN large power requirements it is common to fix the rate of the service upon the time and duration of the occurrence of the maximum demand, as well as upon the amount of this demand. This service has brought the need for a demand meter to give a permanent graphic record. Such a meter is illustrated herewith and is a recent development of the Westinghouse Electric & Manufacturing Company, East Pittsbugh, Pennsylvania.

This instrument, known as type RA, in one unit



WESTINGHOUSE RECORDING-DEMAND METER

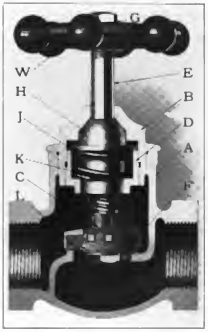
measures both the kilowatt-hours consumed and the integrated demand. It indicates on a four-counter dial the total kilowatt-hours consumed and records on a graphic record the integrated demand under predetermined time intervals. The measuring and recording elements are mechanically inter-connected; there are no electrical contacts to become inoperative. The recording element is controlled by a high-grade clock. The measuring element is the standard Westinghouse type OA watthour meter with special gear train.

Sandusky Packless Valve

THE feature of the globe valve illustrated below is the absence of all packing around the stem. It is one of the new line being manufactured and introduced by the Sandusky Packless Valve Company, Sandusky, Ohio.

In place of the usual packing nut or gland the stem, center piece and bonnet when in contact form a ground joint between the rounding or hemispherical surface of the center piece and the inside tapered surface of the bonnet. A helical spring around the stem presses against the lower flange of the center piece holding this ground joint tight. The nut containing the spring serves to hold the lower end of the stem central with the body of the valve, and also comes in contact with the flange of the center piece so that the ground joint remains tight regardless of the downward or side pressure of the hand-wheel.

The lower end of the stem has a double left-hand Acme thread. The opening and closing of the valve



SANDUSKY PACKLESS VALVE

is done by the threaded stem of the disc holder which fits in the lower end of the stem. Guides on the disc holder engage another guide on each side of the body preventing the disc holder from turning when the hand-wheel is turned so that the two threads must function and raise the disc from the seat. The disc is held in place in the holder by means of a lock nut so that it can be renewed if necessary without removing the valve from the pipe line.

15-inch Crawford Lathe

THE latest model of the Crawford lathe manufactured by the Joseph Crawford, Jr., Company, Erie, Pennsylvania, is shown in the accompanying illustration. Listed as a 15-inch lathe it swings over the ways 16½ inches; over the carriage 9¼ inches; the maximum distance between centers is 34 inches; the back gear ratio is 8½ to 1, and the gear box is arranged to cut threads from 2 to 210 per inch. The centers are Morse taper No. 3, and the spindle sleeve is Morse taper No. 5.

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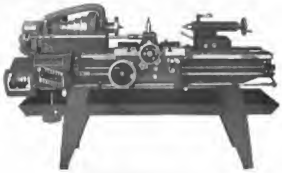
The general features of construction follow well established design. The hollow spindle is made from a carbon-steel forging finished and ground; the bearings are bronze bushed; both the longitudinal and cross feeds are friction driven and can be quickly thrown in or out. The cross feed screw is provided with micrometer adjustment.



NEW CRAWFORD LATHE

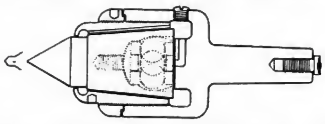
For cutting threads the lead screw is used and by shifting the position of the two handles on the feed box 48 different speeds for threading and feeding can be obtained. A separate rod is provided for the feeding mechanism.

The lathe can be provided with a taper turning attachment, and a spiral relieving attachment to do both inside and outside relieving on either right-hand or left-hand work or any number of flutes from 2 to 28 inclusive. Four cams are furnished, each arranged to relieve 3/32 inch in depth.

The regular equipment includes a double friction countershaft, two face plates, steady and follow rests and wrenches.

Ballbearing Lathe Center

THE ballbearing lathe center shown herewith has been developed for the use of metal spinners and wood turners. The central revolving stem is large to give radial end support. It has a floating tri-thrust ballbearing. A stem cap or bearing is provided with oil channels and drip retainer, and is adjustable in the housing by means of a lock ring. The oil chamber



is connected with both stem and ballbearing. The shank is in one piece with the housing, and supplied with an extension rod for knock-out. This tool is manufactured by J. A. Moller of New Rochelle, N. Y.

Master Pressure Gages

TWO master pressure gages have recently been placed on the market by the Ashton Valve Company, Boston, Mass. One of these, the master pilot pressure gage, is shown herewith.

The other type, known as the Standard master pressure gage, is intended for use in large power plants where it is desirable to have a gage that can be readily from any location, and wherefrom the steam pressure can be easily read. When installed at one end of a boiler or engine room the single dial style is used, but if the location is at the center of the room the double dial style is preferable. To provide for poorly lighted applications, or night service, these gages are made with a specially illuminated dial of opal glass so ar-

ASHTON MASTER PRESSURE GAGE

ranged that electric lamps can be inserted inside of the gage thus illuminating the back of the dial, and making it possible to see the indicating hand and graduations at all times.

The master pilot pressure gage illustrated differs from the standard master gage by having a dial graduated to show only a pressure scale such as is used in the ordinary range of working purposes.

A Turbo Pump Valve

THE principle behind the Worden pump valve is that wear is prevented for the valve will never seat successively twice in the same place. Several pockets, as shown in the illustration cause the valve to rotate.

TURBO PUMP VALVE

One side of each pocket is at an acute angle and the other is square with the face. The action of the liquid as it rises upward through the valve seat is to strike the square side of the pocket and cause the valve to turn.

This action of the valve whereby it does not seat

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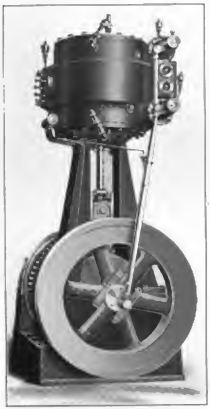
twice in the same place successively tends to bring about a minimum of wear and a condition that is self-cleaning.

The valve is a product of the John-Roger Company, Coopersville, Mich.

Vertical Rotative Dry Vacuum Pump

TO meet the demand of shipbuilders and the designers of power plants who are anxious to save as much space as possible a vertical type of dry vacuum



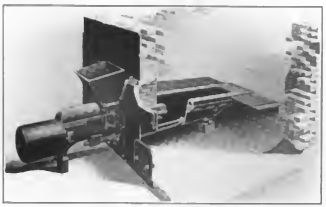
VERTICAL TYPE DRY VACUUM PUMP

pump has been brought out by the Wheeler Condenser & Engineering Company of Carteret, N. J., and is illustrated herewith. Where much condensing is to be done and where high vacuum must be maintained a motor or turbine-driven centrifugal pump can easily take care of the condensate while the pump shown withdraws the air. As the illustration shows the inlet valves of this pump are of the semi-rotative type and are so manipulated by the valve gear as to draw air from the condenser during full stroke. Clearance difficulties are eliminated by providing ports which register with an equalizing passage. The valves are of the poppet type and are easily accessible. The valve arrangement is such as to give perfect drainage at all times.

Moloch Underfeed Stoker

A STOKER constructed along established lines embodying the principle of underfeed firing, in which the coal is brought from beneath and pushed up through the distillation and coking zone of the fire, is illustrated in Figures 1 and 2. Of these, the first illustration shows a general view of the completed stoker as applied to boilers and furnaces for industrial purposes. Figure 2 is a sectional view through the cylinder and operating mechanism. This stoker is a product of the Moloch Stoker Company, Chicago, Illinois.

Important features of its design are the mechanical arrangement of its parts and the operation of the timing device developed with the purpose of decreasing the amount of steam necessary actually to operate the stoker itself. The main cylinder is lagged and jacketed to reduce condensation. The cylinder and all parts connected with it, including the ram and pusher rod, can be removed from the ram case by unbolting the cylinder and pulling the mechanism through the ram case. This can be done without disconnecting any of the steam pipes.



MOLOCH UNDERFEED STOKER

Side plates provided below the hopper can be taken off and obstructions removed from in front of the ram, should any be found. This can be done without removing the coal from the hopper or the hopper itself.

The retort is made in sections to prevent cracking of the main body. As the upper parts holding the tuyere block are sectional they are easily removed. The dead plates are made in sections to prevent warping.

Referring to Figure 2, it will be seen that the main operating valve, placed on the ram case, consists of two steam thrown valves in one casing, each set of pistons taking care of its respective end of the cylinder. The pistons are held in position by means of an overbalancing area of the larger against the smaller.

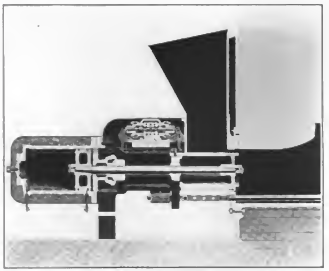


FIG. 2. SECTION OF STOKER MECHANISM

In the position of the ram as shown in Figure 2, to make an operating cycle the chamber of the operating valve nearest the cylinder end is thrown open to exhaust by the timer valve thus relieving the pressure of the large piston at that end and causing the pressure

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of the two smaller pistons to drive the valve forward until the small piston passes the stoker port, thus connecting this with the main steam chamber in the cylinder. This action drives the ram back, and when it comes practically to the end of its stroke the pin on the ram case engages with the lever and the motion of the ram causes the main valve to be pushed back to its seat thus cutting off the steam supply to the main cylinder. The exhaust from the timer valve is then shut off and steam at boiler pressure again admitted in the chamber of the larger piston thus holding this valve in its normal position without the aid of the pin on the arm.

The same operation then takes place with the other end of the pistons of the main operating valve, thus bringing the ram back into the position shown in the illustration when the machine is ready for the next cycle.

Eight gradations of speed are available from zero to maximum. These are all obtained by moving the handle of the timing device to various holes corresponding with the speeds desired. The main shaft of the timer mechanism is so arranged that by using an ordinary monkey wrench the timer valve can be operated by hand without throwing the mechanism into operation.

Thread Gage Testing Machine

A COMPARATOR for the comparison of working thread gage and master thread gage has been developed by the Coats Machine Tool Company, Inc.,

THREAD GAGE TESTING MACHINE

New York City, by applying a Prestwich fluid gage to a Wilhelm pitch diameter comparator. This instrument may also be used for establishing the value of a master gage by using it in combination with swedish gages or other verified standard blocks. The machine consists of a base carrying an upright overhanging standard or column. In the base is set a true lapped steel plate, which is set square with a hole through the standard in which slides a bar carrying the supper measuring points in the form of a double roll. These measuring points rest on both walls of the upper part of the thread to be measured.

Underneath the thread gage that is being measured are five-sided parallel blocks made with the same degree of accuracy as standard space blocks, the two upper surfaces coming together at an angle equalling the angle of the thread to be measured. These blocks are set on the lapped steel base plate at the base of the instrument and the gage rests upon them.

Accuracy of reading is obtained by use of a Prestwich fluid gage. The upper thread measuring roll is carried on the lower end of a vertically slidable spindle. The upper end of the spindle rests on the upper part of the diaphragm of the fluid gage, and in this way gives a reading on the gage column.

After a thread gage has been measured, if a second one is inserted into the instrument and is of the same size the fluid gage will give the same reading. If the second thread gage is larger the fluid gage reading will be higher than before, and if it is smaller the indicating column of the fluid gage will not rise as high as before.

The instrument has a capacity for all thread gages from ¼ to 10 inches in diameter. This large size comparator has been developed for the use of the United States Government in the manufacture of munitions. A similar instrument for the same purpose having a smaller ranger is also manufactured.

48-inch Relief Valve

THE accompanying illustration shows a horizontal exhaust relief valve recently made by the G. M. Davis Regulator Company, Chicago, Illinois. It is to be used as a safety release for the condenser on a new

DAVIS 48-INCH RELIEF VALVE

turbine unit. It has a valve disc 48 inches in diameter; it measures 7 feet 5 inches face to face of the flanges and weighs 4000 pounds. The valve disc has a bearing metal face, which seats on a brass ring. The valve is water sealed and is double cushioned with brass-lined dash pots above and below the disc. The valve stem is 3½ inches in diameter.

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New Britain Automatics

FIGURE 1 illustrates size 3, New Britain multiple spindle chucking machine, work-revolving type.

This machine although designed to handle much the same variety of work as regular single-head automatic chucking machines has two points of difference; namely, (a) the work is held and revolved by the spindles, the tools being fixed in the tool slide; (b) the use of cross-slide tools is rendered possible, a feature lacking in the type where the work is held stationary. The machine has six spindles of hammer forged, heat treated, hardened and ground chrome-nickel steel. The spindle

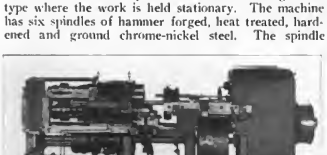

FIG. 1. MULTIPLE SPINDLE CHUCKING MACHINE

bearings are of bronze, ground straight inside and tapered outside. To retain the original accuracy of the machine provision is made for taking up wear in the bearings without disturbing their alignment; ball thrust collars are provided on the spindles to take the end thrust of the cutting tools; change gears provide five rates of spindle speeds and twelve variations of feed.

The base of the machine forming the chip pan extends to the floor without legs. That portion of the bed directly beneath the work has a 45 degree incline toward the back so that chips are at once carried to the side. At this point the chip pan is widest and slopes toward the rear where is located a strainer and oil well from which oil is taken for distribution to the work. The whole distributing system is designed to avoid as much external piping as possible. This is accomplished by conveying the oil through the inside of the tool-slide into a chamber surrounding the driving shaft bushing, from this point it is tapped off at the circumference through short tubes to the individual tools. The oil pump is driven at constant speed.

Hand control levers in easy reach of the operator enable the power feed to be instantly started or stopped. A hand-feed crank is provided for testing all feed movements and tool positions. To insure protection to the operator, the spindle is automatically disconnected from the drive during loading and unloading of the chucks.

The indexing mechanism is patterned after the Geneva stop motion; the differential motion index is regularly fitted to this machine and indexes the spindle cylinder and operates the tool-slide at high speed when the tools have finished cutting; special draw-in spring collets are employed which operate satisfactorily where pieces do not show a variation exceeding 1/32 inch in diameter; if desired the machine may be equipped with a special air-chucking attachment; a threading attachment may be installed in fourth tool slide position; the tool slide cam is laminated similar to a leaf spring, this permits of adjustment of one cam to all lengths of work within the capacity of the machine.

As the direction of rotation of spindle is right-handed, standard tools, drills, reamers, etc., are used.

Figure 2 shows another new automatic, the New Britain sextuple automatic bar machine for such work as blanking rolls, sleeves, couplings, and the like.

In many respects this six-spindle automatic machine is similar in construction to the New Britain six-spindle automatic machine described above. However, the cylinder spindle does not index as the machine is designed to feed, drill, chamfer and cut off in each position. On simple work this makes possible production

FIG. 2. SEXTUPLE AUTOMATIC BAR MACHINE

from six spindles instead of from one as on single-spindle machines.

The general features of the spindles, spindle bearings and ball thrusts are the same as on the machine previously described. The change gears provide six rates of spindle speeds and a separate system of change gears is provided for effecting changes in feed by varying the speed of the cam shaft.

The differential motion, tool-slide, tool-slide cam, base, oil distributing system and hand control levers are the same in this design as in the machine first described.

Standard drills are used as the direction of the spindle rotation is right handed. The machine may be equipped for either single belt or motor drive.

Both of these machines are recent products of the New Britain Machine Company, New Britain, Connecticut.

"Wisconsin" Universal Grinder

THE Wisconsin universal grinder has been designed to handle all kinds of tool and cutter grinding, as well as cylindrical, internal and surface grinding within the limits of its capacity.

The base of the machine is 24 inches square at the bottom, with a door at the back to give access to shelf space for the storage of tools and fixtures. The column is of a box section, carrying the vertical slide for the knee and supporting in a flange, as shown, the bronze nut for the knee elevating screw. Wheel spindle head is attached directly to upper end of the column.

The knee is of a box section entirely enclosed, except for the opening for the elevating screw. On one side is a tee slot carrying the stops for the cross feed. The saddle is substantially ribbed and fitted to the knee with a long bearing.

The table is supported on a sub-table giving a cylindrical bearing at the center and supporting pads at the ends. This table can swivel 90 degrees each way, and is graduated both in degrees at the center and for tapers per foot.

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The table surface is 5 inches wide by 36 inches long; the longitudinal table movement 20 inches; transverse table movement 8 inches; vertical table movement 9 inches; swing of centers 10 inches in diameter; the internal grinding attachment grinds holes 9/16 inch diameter and larger, by 4 inches deep.

UNIVERSAL GRINDER

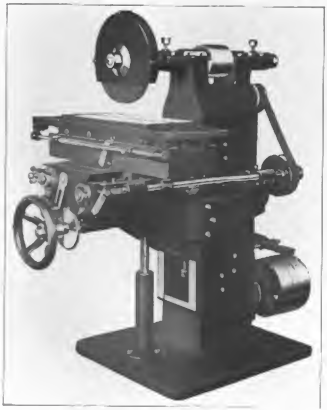
This machine is manufactured by the Dauber-Kratsch Co., Oshkosh, Wisconsin.

No. 2 Surface Grinder

AN automatic surface grinder of the knee-and-column type manufactured by the Noble & Westbrook Manufacturing Company of Hartford, Connecticut, is herewith shown.

The general features of construction follow standard design. Care has been made to protect all working parts from dust. The mechanism for raising and lowering the table is provided with ball thrust bearings; micrometer dials control the movement of the feeds. The spindle is made of crucible steel, and all slides and the spindle have take-up bearings. The cross slide is equipped with an automatic stop as a safeguard and the platen can be started or stopped instantly by using the hand lever and without stopping the spindle or other parts of the machine.

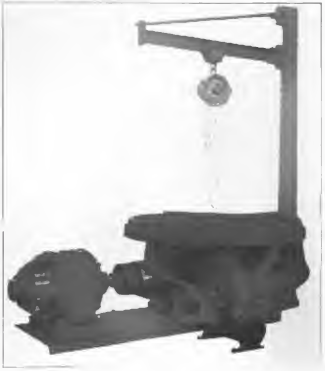
The working surface of the table is 8 x 20 inches in size; distance from the center of the spindle to the top of the table 13½ inches, the spindle flanges are adapted



NO. 2. SURFACE GRINDER

Vertical Disk Grinding Machine

A VERTICAL disk grinding machine embodying the features of a self-contained hoisting attachment for handling heavy work, a dust exhaust system, and means for adapting the machine for direct motor drive,



has recently been brought out by the Gardner Machine Company, Beloit, Wisconsin. The accompanying illustration shows these general features.

The machine is equipped with a disk wheel 53 inches in diameter designed for heavy grinding. This wheel is supported by a cast-iron flange 20 inches in diameter and 13/16 inches thick, supported on the upper end of a vertical spindle 3⅝ inches in diameter. This spindle is driven by a pair of hardened steel bevel gears. The spindle thrust is taken on self-aligning radial ball bearings. The hoisting attachment consists of a ¼-ton, hand-operated chain hoist mounted on a trolley and swinging jib. The supporting column is rigidly attached.

The dust exhaust system includes a belt driven fan whose suction manifold is connected through four openings with the bottom of a dust channel cast into the base of the machine, around and just below the edge of the wheel. A detachable guard ring permits the removal of coarse particles.

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Personal and Business Items

In its bulletin entitled "Fundamentals of Illumination Design," the Engineering Department of the National Lamp Works of the General Electric Company has presented in simple and readable language a discussion of the broad principles which underlie illuminating engineering practice. It is a bulletin which should prove of value to schools and colleges, but its usefulness is not limited to students, however, for much of the material presented is the result of recent investigations, and the data will bear the closets scrutiny of the practicing illuminating engineers. Industrial lighting, light projection, protective lighting, etc., are taken up.

Mr. Guy E. Tripp, of New York, Chairman of the Westinghouse Electric and Manufacturing Company, has been appointed chief of the Production Division of the Ordnance Bureau of the War Department. He is entrusted with the task of supervising and stimulating the production of all ordnance material and supplies. He has been given a commission with the rank of Colonel.

Ford, Bacon & Davis, Engineers, New York, N. Y., announce the formation of the Ford, Bacon & Davis Corporation, organized for the purpose of conducting a general contracting business, with particular reference to industrial, public utility and power plants, steam and street railroads, docks, steamship and railway terminal facilities, subways, tunnels, hydro-electric and irrigation projects. In effect this means the continuance in corporate form of construction work which heretofore has been handled by the firm direct.

Mr. John D. Stout has been appointed Chicago representative for the Terry Steam Turbine Company of Hartford, Conn. Mr. Stout was at one time Assistant Engineer of the Terry Steam Turbine Company, and was recently transferred from the New York office where he was Assistant Manager.

The Cleveland Automatic Machine Tool Company, of Cleveland, Ohio, has recently published for complimentary distribution an attractive booklet entitled "31 Articles by J. P. Brophy." A sub-title states that these deal with mechanical information, municipal problems, political problems, human qualities, humor, war and general business administration. Most of them have been published from time to time in the technical and trade papers. Mr. Brophy's writings always attract attention for he is a man of conviction and writes what he believes. Many of his comments run counter to opinions freely expressed in business circles; as for instance, his skepticism as to the era of large business immediately after the close of the war. All of these opinions are backed up by facts and at once command attention. Any industrial manager will find that it is well worth-while to read this little book.

Mr. J. H. Pardee, President of the J. G. White Management Corporation, New York, and Mr. J. P. Ripley, Engineer, have returned to New York from a general inspection of the Manila Electric Railroad & Light Company, and other interests in the Philippine Islands operated by The J. G. White Management Corporation.

Technical information regarding Bakelite Micarta-D Gears is contained in a twelve-page pamphlet recently published by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The distinctive features of this material for noiseless gears and pinions are listed together with its physical properties. Methods of turning and drilling and gear cutting are described and illustrated with halftones and drawings. Methods of attaching to the driving shaft which have proved suitable for gears of all sizes are shown, and tables of pitch, teeth and other gear data are also given. There are formulas for horsepower rating, the amount of power which can be transmitted through press fits and for calculating other variables in gear practice.

An attractive catalog of grinding and polishing machinery has just been issued by the Gardner Machine Company, Beloit, Wis. In addition to illustrating, describing and giving general information in regard to their line of grinding machines, accessories and supplies, there are several pages of general information in regard to the use of abrasive disks. The catalog is attractively printed, containing 115 pages.

Mr. George L. Hedges has resigned his position with the Kelman Electric & Manufacturing Company, of Los Angeles, Cal., to report at Washington, D. C., for active duty as First Lieutenant in the Officer's Reserve Corps, Ordnance Department.

The Griscom-Russell Company, New York City, N. Y., have just published a small folder illustrating and briefly describing their line of power plant equipment which includes feed water heaters, oil heaters, oil coolers, evaporators, expansion joints, grease extractors, steam and oil separators and Russell steam engines.

Catalogue 8-E has just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penn., describing all of the industrial electric heating apparatus manufactured by that firm. The line includes steel clad heaters for many industrial processes, immersion type water heaters, stoves or various forms, chocolate warmers, tailors' irons and electric oven heaters for use in enameling.

Mr. E. F. Lake, metallurgical engineer, has taken the position of assistant superintendent of the Rich Tool Company, Chicago, Illinois. The company is manufacturing one piece valves from high speed steel for airplane and automobile engines.

The Hoppes Manufacturing Company, Springfield, Ohio, announces the recent appointment of Mr. W. R. Jennison as their Southeastern representative. He will handle the entire line of the firm's products in that district with headquarters at 407 Bisbee Building, Jacksonville, Florida.

At the annual meeting of the Engineering Society of York, Penn., held recently, the following officers were elected for the ensuing year: President, James Rudisill; Vice-President, Chauncey D. Bond; Secretary, M. Haller Frey, Polack Building; Treasurer, Harold A. Russell; Directors: George A. Jessop, Charles L. Berger and Howard J. Longenecker.

The Western Efficiency Society has elected the following officers for 1918: President, F. A. Carlisle; First Vice-President, S. E. Stout; Second Vice-President, J. R. Shea; Secretary and Treasurer, George C. Dent.

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EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, in *the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Special publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly	Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
AERA	AERA	Instn Mech Engrs	Institution of Mechanical Engineers
Aeronts	Aeronautics	Inst Met	Journal of the Institute of Metals
A I C E	Amer. Institute of Chemical Engineers	Instn Min Engrs	Institution of Mining Engineers
A I E E	Amer. Institute of Electrical Engineers	Instn Min & Met	Institution of Mining & Metallurgy
A I M E	Amer. Institute of Mining Engineers	Int Mar Eng	International Marine Engineering
A I Mt	Amer. Institute of Metals	Iron Age	Iron Age
Am Ez Rev	Amer. Economic Review	Ir & Cl Trds Rev	Iron & Coal Trades Review
Am ElsChem Soc	Amer. Electro-Chemical Society	Iron Trd Rev	Iron Trade Review
Am Fdymn Assn	Amer. Foundrymen's Association		
Am Ir & Stl Inst	Amer. Iron & Steel Institute	Jl Actcy	Journal of Accountancy
Am Jl Pub Hlh	Amer. Journal of Public Health	Jl Geol	Journal of Geology
Am Jl Sci	Amer. Journal of Science	Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
Am Mach	Amer. Machinist		
Am Rd Blds Assn	Amer. Road Builders' Association	La Eng Soc	Louisiana Engineering Society
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association	La Nat	La Nature
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.	L S Min Inst	Lake Superior Mining Institute
Am Soc Mar Dftsn	Amer. Society of Marine Draftsmen		
Am Soc Nav Engrs	Amer. Society of Naval Engineers	Machy	Machinery
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers	Manr Assn Engs	Manchester Assn. of Engineers
Am Soc Test Mat	Amer. Society of Testing Materials	Mfrs Rec	Manufacturers' Record
Am Wd Pres Assn	Amer. Wood Preserv. Association	Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Am Wt Wks Assn	Amer. Water Works Association	Mar Rev	Marine Review
A R E A	Amer. Railway Engineering Association	Max Boil Mkrs Assn	Master Boiler Makers' Association
A R M M A	Amer. Railway Mas. Mech. Assn.	M C B A	Master Car Builders' Association
Arch For	Architectural Forum	Mech Eng	Mechanical Engineering
Arch Rec	Architectural Record	Mech Wld	Mechanical World
A S C E	Amer. Society of Civil Engineers	Met & Chem Eng	Metallurgical & Chemical Engineering
A S M E	Amer. Society of Mechanical Engineers	Min Mag	Mining Magazine
Assn Eng Soc	Association of Engineering Societies	Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Assn I S E E	Association of Iron & Steel Elec. Engrs.	Min & Sci Pr	Mining & Scientific Press
Aus Min Stan	Australian Mining Standard	Mun Eng	Municipal Engineering
Auto	Automobile	Mun Engrs Jl	Municipal Engineers' Journal
Autocar	Autocar	Mun Jl	Municipal Journal
Bkn Engs Cb	Brooklyn Engineers' Club	Nat Assn Corp Schls	National Assn. of Corporation Schools
Bos Soc C E	Boston Society of Civil Engineers	Nat Engr	National Engineer
Br Rds & Sts	Better Roads and Streets	Nat Lme Mfrs Assn	National Lime Manufacturers' Association
Brs Wld	Brass World	Nature	Nature
Bt Fe & Stl Pt	Blast Furnace & Steel Plant	N E C Instn	N-E Coast Institution
		N E Rd Cb	New England Railroad Club
Can Engr	Canadian Engineer	N E Wr Wks Assn	New England Water Works Assn.
Can Min Jl	Canadian Mining Journal	N Y Dept Labor	New York State Dept. of Labor
Can Soc C E	Canadian Society of Civil Engineers	N Y Rd Cb	New York Railroad Club
Cas Eng Mthly	Cassier's Engineering Monthly		
Cen Ry Cb	Central Railway Club	Per-Way Instn	Permanent-Way Institution
Chem Eng & Min Rev	Chemical Engineering and Mining Review	Phil Jl Sci	Philippine Journal of Science
C E Soc St P	Civil Engineers Society of St. Paul	Power	Power
Cl Age	Coal Age	Pwr Pt Eng	Power Plant Engineering
Colby Gdn	Colbery Guardian	Prof Mem	Professional Memoirs
Col Sl Min Mag	Colorado School of Mines Magazine		
Col Univ Qly	Columbia University Quarterly	Quarry	Quarry
Com Air Mag	Compressed Air Magazine		
Com Vhle	Commercial Vehicle	Roy Un Ser Instn	Royal United Service Institution
Comwh Engr	Commonwealth Engineer	Ry Age Gaz	Railway Age Gazette
Concte	Concrete	Ry Cb Pitts	Railway Club of Pittsburgh
Contg	Contracting	Ry Engr	Railway Engineer
Contr	Contractor	Ry Gaz	Railway Gazette
Corn C E	Cornell Civil Engineer	Ry & Loco Eng	Railway & Locomotive Engineering
Cr Min West Aust	Chamber of Mines of West Australia	Ry Mech Engr	Railway Mechanical Engineer
		Ry Rev	Railway Review
E Cb Balt	Engineers' Club of Baltimore	Ry Sig Engr	Railway Signal Engineer
E Cb Phila	Engineers' Club of Philadelphia		
E Cb St L	Engineers' Club of St. Louis	S A E	Society of Automobile Engineers
Econ Geol	Economic Geology	Schl Min Qly	School of Mines Quarterly
Eff Soc Jl	Efficiency Society Journal	Sfty Eng	Safety Engineering
Elec Jl	Electric Journal	Sib Jl Eng	Sibley Journal of Engineering
Elec'n	Electrician	So Af Inst Engrs	South African Instn. of Engineers
Elec Rev	Electrical Review	Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Elec Rev Chi	Electrical Review, Chicago	Soc Pro Sci Man	Soc. to Promote Sci. of Management
Elec Ry Jl	Electric Railway Journal	S & S W Ry Cb	Southern & Southwestern Railway Club
Elec Wld	Electrical World	St L Ry Cb	St. Louis Railway Club
Eng & Con	Engineering and Contracting	Stev Indic	Stevens Indicator
Eng & Min Jl	Engineering and Mining Journal	Stl & Iron	Steel & Iron
Eng Ed	Engineering Education	Surv'r	Surveyor & Municip. & County Engr.
Eng News Rec	Engineering News-Record		
Engng	Engineering	Tel Engr	Telephone Engineer
Engr	Engineer	Telephony	Telephony
Eng Ry	Engineering Review	Times Eng Supp	Times Engineering Supplement
Engr Soc Penn	Engineers Society of Pennsylvania	Tmwy & Ry Wld	Tramway & Railway World
Fkn Inst Jl	Franklin Institute Journal	Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Flying	Flying	Univ Jl	University of Illinois
Fndry	Foundry	Univ Kan	University of Kansas
		Univ Minn	University of Minnesota
Gen Elec Rev	General Electric Review	Univ Mo	University of Missouri
		U S Bur Mines	U. S. Bureau of Mines
Ht & Vtg Mag	Heating and Ventilating Magazine	U S Bur Stds	U. S. Bureau of Standards
Ice & Refrig	Ice & Refrigeration	U S Dept Ag	U. S. Dept. of Agriculture
Ill Eng Soc	Illuminating Engineering Society	U S Geol Surv	U. S. Geological Survey
Imp Inst Bul	Bulletin of the Imperial Institute	U S Nat Inst	U. S. Naval Institute
Ind Man	Industrial Management		
InstAut Engrs	Institute of Automobile Engineers	West Eng	Western Engineering
Inst Rad Engrs	Institute of Radio Engineers	West Ry Cb	Western Railway Club
Inst San Engrs	Institute of Sanitary Engineers	West Scot I & S Inst	West. Scotland Iron & Steel Inst.
Instn C E	Institution of Civil Engineers	West Soc Engrs	Western Society of Engineers
Instn E E	Institution of Electrical Engineers	Wis Engr	Wisconsin Engineer
Instn E & S Scot	Inst. of Engrs. & Shipbldrs. of Scot.	Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

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The Engineering Index

The following pages form a *descriptive* index of the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX

INDUSTRIAL MANAGEMENT

EDUCATION

Agriculture

L'Importance Economique De L'Enseignement Agricole (83929 C). H. M. Nagant. 4500 w. Revue Trimestrielle Canadienne—Nov., 1917. Economic importance of the study of agriculture.

Apprentices

Apprenticeship Training—Including an Account of a Possible System of Continued Education for Engineering Apprentices (83880 N). A. P. M. Fleming. 34 pp. Instn E & S Scot, Trans—Dec., 1917. Principles and basic requirements.

The Training of Engineering Apprentices (83383 A). Addresses by A. E. Carter and by R. W. Bailey. (Slightly abridged.) 8000 w. Engng—Dec. 14, 1917. Recommendations of educators.

Apprenticeship

Improved Apprenticeship Methods on the Pennsylvania (83728). J. H. Yoder. Ills. 2000 w. Ry Mech Engr—Jan., 1918. Latest developments in the course.

Chemistry

L'Avenir De L'Industrie Chimique En France (83938 B). A. Kling. 4000 w. Le Génie Civil—Nov. 24, 1917. Future of industrial chemistry in France.

La Chimie Industrielle (83930 C). L. Bourgoin and P. Le Cointe. 4000 w. Revue Trimestrielle Canadienne—Nov., 1917. Introductory lecture of a new course.

Craftsmen

The Education of Skilled Craftsmen (83695 A). C. A. Otto. 1000 w. Mech Wld—Jan. 4, 1918. Suggestions.

Crippled Soldiers

The Engineer, the Cripple and the New Education (83335 A). Frank B. Gilbreth and L. M. Gilbreth, with discussion. 7000 w. A S M E, JI—Jan., 1918. Reviews progress in the solution of the problem of training cripples.

Efficiency

Under New Management—A Man's Power (83948 A). Charles M. Horton. 3000 w. Ind Man—Feb., 1918. Possibilities of man's achievements.

Engineering Instruction

Special Education in Time of War (83327 A). Charles S. Howe. 2500 w. A S M E, JI—Jan., 1918. Problems of engineering colleges. Efficient training.

Engineering Problems

Universal Public Service in Peace and War (83325 A). Ira N. Hollis. 6000 w. A S M E, JI—Jan., 1918. Training needed; our weaknesses, etc.

Engineers

Some Comments on the Training of Engineers (83893 A). A. C. Lanier. 5000 w. E Cb St Is, JI—Nov.-Dec., 1917. Suggestions based on experience.

The Engineer in the Chemical Industry (83605 A). H. E. Hollister. 1800 w. E Cb Phila, JI—Jan., 1918. Work accomplished since the war.

Laboratory Apparatus

Electrical Laboratory Apparatus for Educational Institutions (83621 A). J. J. Lamberty. Ills. 1200 w. Gen Elec Rev—Jan., 1918.

National Defense

The Engineering Societies in the National Defense (83326 A). Gano Dunn. 4500 w. A S M E, JI—Jan., 1918. Things that are being done by engineers.

Reinforced Concrete

Some Observations Regarding the Methods of Teaching the Theory of Reinforced Concrete Design (83801 A). Allen B. McDaniel. 1500 w. Eng Ed—Dec., 1917. Suggests methods.

Research

American Research Methods (83868 B). Charles H. McDowell, with discussion. 20 pp. West Soc Engrs, JI—Oct., 1917. Urges co-operation between industries and educational institutions.

The Co-ordination of Research (83911). 1300 w. Nature—Dec. 6, 1917. Prevailing opinions on the subject.

The Opportunity for Industrial Research (83337 A). C. E. Skinner. 2500 w. A S M E, JI—Jan., 1918. The study of alloys.

See also Heat Flow, under MECHANICAL ENGINEERING, *Heating and Cooling.*

Schools

The Engineering School and the War (83799 A). A. F. Barnes. Presidential address to the S-W. Soc. of Engrs. 3000 w. Eng Ed—Dec., 1917. The effect of the war on American industries.

Spelling

How to Awaken Freshman Interest in Good Spelling (83802 A). A. C. F. Baebenroth. 1800 w. Eng Ed—Dec., 1917. Prevalence of faulty spelling.

Symbols

Symbols for Mechanics and Hydraulics (83800 A). John T. Faig. 1000 w. Eng Ed—Dec., 1917. Methods aiming to standardize practice; results obtained.

Training

Technical Training for Disabled Soldiers and Sailors (83317 A). Lord Charnwood, with discussion. 10 pp. Roy Soc Arts, JI—Dec. 14, 1917. Size of the problem and schemes in preparation.

Training Engineers and Firemen (83971 A). Allen W. Ruggles. Ills. 2500 w. Ind Man—Feb., 1918. How the University of Wisconsin is educating them.

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Welding
Plan for Training Welders for Army (83786). 1800 w. Weld Engr—Jan., 1918. Suggestions offered the war department.

FINANCE AND COSTS

Accounting
Accounting for the Liberty Loans (83888 A). Harvey S. Chase. 10 pp. Jl Actcy—Jan., 1918. Serial, 1st part.

Compensation
The Basis of Compensation for the Railroads (83543). Julius H. Parmelee. 1800 w. Ry Age—Jan. 10, 1918. Analysis of provisions suggested by President.

Cooperation
Buying Combinations in the Metal Market (83725). 5000 w. Min & Sci Pr —Jan. 19, 1918. From report on co-operation in American Export Trade; Federal Trade Commission.

Costs
Power Plant Proportional Investment Costs (83324). H. S. Knowlton. 5500 w. Natl Engr—Jan., 1918. Discussed in Boston Edison Street Lighting Rate Case.

Profits
Profit Earned and Profit Collected (83890 A). Frederick Thulin. 8 pp. Jl Actcy—Jan., 1918. Accounting problems.

Railway Finance
Railway Earnings and Expenses for the Year 1917 (83465 A). Frank Haigh Dixon. Diagram. 1800 w. Ry Age—Jan. 4, 1918. (Special No.) Heavy falling off in operating income.

Railroad Securities
How Will the Railroad Securities Be Affected? (83681). 1500 w. Ry Age—Jan. 18, 1918. Charts and review.

Selling Price
Determination of Selling Price (83889 A). E. D. Hilton. 7 pp. Jl Actcy—Jan., 1918. Critical discussion of recent pamphlet by Harrington Emerson.

Taxes
Plan to Recast War Excess Profits Tax (83661 A). 2200 w. Iron Age—Jan. 17, 1918. Important amendments proposed; some effects of Supreme Court decision.

Trade
The Government and Foreign Trade (83738 A). 1200 w. Elec Rev—Dec. 21, 1917. Serial, 1st part. British trade and methods developed for its future.
The Trade of India with Russia, France and Italy (83735 A). D. T. Chadwick, with discussion. 1500 w. Roy Soc Arts, Jl—Dec. 28, 1917. Effects of the war; and the economic future.

Valuation
Developments in Railway Valuation (83707). 5000 w. Ry Rev—Jan. 19, 1918. Statement by H. C. Philips of development of federal valuation.
Solidification as a Factor in Railway Valuation (83683). H. M. Taylor. 1500 w. Ry Age—Jan. 18, 1918. Suggested method for determining the appreciation in the roadbed due to seasoning.
What About Your Plant Values? (83590). E. C. Constans. 1500 w. Telephony—Jan. 12, 1918. Outlines a simple system for valuing telephone plants.

War Revenue
The War Excess Profit Tax (83319). Philip Wiseman. 2800 w. Min & Sci Pr —Dec. 29, 1917. Meaning of "excess profit"; effect of tax law on gold-mining.
War Revenue Act and Its Relation to Taxpayers (83414). Daniel C. Roper. Address before editors of the trade press. 2000 w. Fndry—Jan., 1918.

War Tax
Intangible Values and War Tax (83-972 A). Charles W. McKay. 4500 w. Ind Man—Feb., 1918. Discusses features of the war tax for industrial appraisals.

MANAGEMENT

Economic Departments
Uses of an Economic Department in a Machine-Tool Plant (83665). Ludwig W. Schmidt. 3500 w. Am Mach—Jan. 17, 1918. Reasons why such a department is of value in future policies.

Efficiency
Efficiency by Consent (83949 A). Louis D. Brandeis. 1100 w. Ind Man—Feb., 1918. Necessity of consulting with labor concerning industrial changes to secure full cooperation.
Training a Mining Organization in Efficiency Methods (83803). Charles A. Mitke. 2000 w. Eng & Min Jl—Jan. 26, 1918. Experiences at the Copper Queen.

Index Cards
Getting the Most Out of Index Cards (83973 A). F. J. Schlink. Ills. 2800 w. Ind Man—Feb., 1918. How cards can be notched to give graphic information.

Machine Arrangement
How to Locate Machine Tools (83970 A). Gustav H. Radebaugh. Ills. 2500 w. Ind Man—Feb., 1916. Coördinated system of machine arrangement.

Ordnance
Ordnance Bureau, U. S. A. (83976 A). 700 w. Ind Man—Feb., 1918. Editorial on the vastness of the task and the work of the Bureau.
American Ordnance in France (83339 A). Capt. Fogg. 1000 w. West Ry Cb, Pro—Nov. 19, 1917. Needs of the American Ordnance department.

Organization
An Industrial Achievement of the War (83960 A). L. P. Alford. 2500 w. Ind Man—Feb., 1918. Application of management principles to the U. S. Ordnance Bureau.
Master Control of American Industries (83975 A). 1800 w. Ind Man—Feb., 1918. Editorial on the need of control, with suggestions.
The Winchester Plan of Management (83437 D). W. E. Freeland. Ills. 3500 w. Iron Age—Jan. 3, 1918. (Special No.) Outlines a modified type of functional management, discussing the philosophy on which it is based.
The Winchester Engineering Organization (83660 A). W. E. Freeland. 3000 w. Iron Age—Jan. 17, 1918. Duties of chiefs of general manager's staff and their committee interrelations. Second article of series.
Handling Costs at Winchester Plant (83785 A). W. E. Freeland. Ills. 2500 w. Iron Age—Jan. 24, 1918. Part III.

Production
Production Standards for War (83916). 1000 w. Times Engng Supp—Nov. 30, 1917. Coördination between manufacturers and Government.

Profit-Sharing
A Fair Basis of Profit-Sharing (83974 A). George Kingdon Parsons. 4500 w. Ind Man—Feb., 1918. Unique system, apportioning profits to managers, salesmen, clerks, mechanics and laborers.

REGULATION

Administration Bill
The Administration Bill for Control of Railroads (83544). 6000 w. Ry Age —Jan. 10, 1918. Five-hundred-million appropriation.

Cantonments
Utility Staffs at National Army Cantonments Organized on Military Basis (83455). John M. Goodell. 2500 w. Eng News-Rec—Jan. 3, 1918. Organization for Camp Meade utility service.

Draughtsmen
The Status and Remuneration of Draughtsmen (83381 A). 2200 w. Engng—Dec. 14, 1917. The work; how to raise the status of draughtsmen.

Employees
Keeping the Good Will of the Employee (83349). H. D. Murphy. 1200 w. Am Mach—Jan. 3, 1918. Its importance; ideas on the subject.

Engineering Equipment
Supply Organization Expands 2250 Per Cent. to Equip Engineer Troops (83452). E. J. Mehren. 4000 w. Eng News-Rec—Jan. 3, 1918. Specification, design and purchase of a large variety of engineering equipment.

Fuel Administration
Five Coal-less Days and Ten Heatless Holidays (83821). 3000 w. Ry Age—Jan. 25, 1918. Fuel Administration orders a suspension of industries.
Garfield Defends Order That Shut Down Industries (83826). 2000 w. Cl Age—Jan. 26, 1918. Text of defense, with interview by Floyd W. Parsons.

Government Aid
Engineering Societies' War Activities (83478). 2500 w. Elec Wld—Jan. 5, 1918. Ways in which national technical societies have aided government.

Industrial Order
Widespread Closing Down of Industry (83784 A). 13 pp. Iron Age—Jan. 24, 1918. To give coal to vessels, relieve freight congestion and fuel shortage.

Labor
Crux of the War Situation is Labor (83536 A). Elbert H. Gary. 3000 w. Iron Age—Jan. 10, 1918. Address before the Commercial Club of Chicago. Favors bringing men from the Orient.
Fifth Annual Report of the Secretary of Labor—Fiscal Year Ending June 30, 1917 (83645 N). 150 pp. U S Gov Print Office—1917. Measures in labor disputes, and other work of the Dept.
Monthly Review of the U. S. Bureau of Labor. Statistics (83795 N). 256 pp. U S Dept. Labor—Dec., 1917.
Railway Labor Conditions (83758 A). 2500 w. Engng—Dec. 28, 1917. Developments in connection with rates of wages in Great Britain. Editorial.
Reducing Labor Turnover in Our Shops (83351). Fred H. Colvin. 2200 w. Am Mach—Jan. 3, 1918. Different phases of the question.
Shop Stewards (83764 A). 1500 w. Engr—Jan. 4, 1918. Discusses the recent agreement in England to recognize the shop stewards.
Unionizing Industry as a War Measure (83538 A). Walter Drew. 1800 w. Iron Age—Jan. 10, 1918. Its dangers.

Manufacturing
Manufacture After the War (83917). 2000 w. Times Eng Supp—Nov. 30, 1917. Problems of federation and association in England after the war.

Power
Mastering Power Production—II (83047 A). Walter N. Polakov. 3500 w. Ind Man—Feb., 1918. Deals with general principles of arrangement and installation of plant equipment.

Public Utilities
Effects of War Conditions on Cost and Quality of Public Utility Service (83564). 2000 w. Elec Ry Jl—Jan. 12, 1918. Extra operating expense should be considered in modifying rates.
Practical Measures for Securing Greatest Economy in Public Utility Plant Operation (83490 A). Charles Brossmann. 2500 w. Mun Eng—Jan., 1918. Serial, 1st part. Specific recommendations for increasing efficiency.

Railroad Hearings
Railroad Hearings Before the Senate Committee (83470 A). 2500 w. Ry Age —Jan. 4, 1918. (Special No.) Interstate Commerce Commission questioned.

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Railroads
Supreme Court Decisions Affecting Railroads (83810). 3000 w. Ry Age—Jan. 25, 1918. Abstracts of decisions in the Illinois and the Texas cases.

Steel
First of Government Regulation in Steel (83445 D). 4500 w. Iron Age—Jan. 3, 1918. (Special No.) Record ingot production.

War Board
Accomplishments of the Railroad's War Board (83471 A). 3500 w. Ry Age—Jan. 4, 1918. (Special No.) Report to Senate Committee tells also of what it had hoped to do.

War Industries
War Industries Board to Be Central Agency for Mobilizing Nation's Resources (81775). 1500 w. Eng News-Rec—Jan. 24, 1918. Plan outlined by Secretary Baker.
Germany's Contribution to Our War Preparation (83438 D). Ills. 1500 w. Iron Age—Jan. 3, 1918. (Special No.) A Bridgeport, Conn., plant, financed by Germany, for the production of shrapnel, taken over by U. S. government.

Women Workers
One Labor-Shortage Problem Solved—Women in Machine Shops a Success (83530). 2000 w. Eng News-Rec—Jan. 10, 1918. Efficient work on machine tools.
The Woman Worker. John W. Upp. Also, Psychology of Environment. C. B. Lord. With discussion of the two papers (83334 A). Ills. 7000 w. A S M E, Jl—Jan., 1917. Problems concerning women.
Women Fill Men's Places in Shops (83720 A). Articles by D. C. Buell, Harvey D. Wolcomb, and Margaret Lampert. 4500 w. Ry Mech Engr—Jan., 1918. Suggestions for their training.
Woman Power (83924). 1100 w. Times Engng Supp—Nov. 30, 1917. Account of the Exhibition of Women's Work.
Women in German Foundries (83771 A). From paper by Kurt Abeking in *Stahl und Eisen*. Ills. 1500 w. Ir & Cl Trds Rev—Dec. 28, 1917. Considers kinds of work and ways of instruction.
Women's Labor in British War Industries (83662 A). L. H. Quin. Ills. 4000 w. Iron Age—Jan. 17, 1918. Its great scope and problems involved; wages, efficiency and working conditions.

WELFARE AND SAFETY

Benefit Association
The Employes' Benefit Association (83908 A). W. L. Chandler. Charts. 6000 w. Ind Man—Feb., 1918. Second part of serial. Its relations to employee and employer and its management. Sick benefits, insurance, etc.

Dust
Dust in Industry (83887 A). Henry Field Smyth. 3000 w. Sci Am—Jan., 1918. As a cause of occupational diseases.
Dust; Its Universality, Elimination and Conservation (83956 D). E. R. Knowles. Ills. 43 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Classification of dusts, their sources, elimination, recovery.

Safety Work
A Year's Progress in Electrical Safety Work (83518). Morton G. Lloyd. 2500 w. Elec Rev, Chi—Jan. 5, 1918. Results of first year's trial of the Natl. Elec. Safety Code.

Workmen's Compensation
Workman's Compensation Act (83474). Samuel R. Artmas. 2500 w. Telephony—Jan. 5, 1918. Read at Indiana Ind. Tel. Convention. Experiences in administration.

MISCELLANY

Agriculture
The Agricultural Problem (83328 A). Liberty H. Bailey. (Abstract.) 3000 w. A S M E, Jl—Jan., 1918. Food production problems and their relation to the war.

German Industries
A Travers Les Revues Techniques Allemandes (83904 B). 2000 w. La Nature—Nov. 24, 1917. Extraction of greases, production of high-speed steel; copper, leather, rubber, and other industries as gathered from German technical papers.

War
The Business of War (83490). Charles T. Hutchinson. 2500 w. Min & Sci Pr—Jan. 5, 1918. Reviews conditions and the attitude of the industries and of labor.

War Aims
What We're Fighting For (83657). Frederick Landis, with introductory address. 22 pp. St L Ry Cb, Pro—Dec., 1917.

War Effects
Manchester Local Section: Chairman's Address (83613 N). C. J. Beaver. 8000 w. Instn E E, Jl—Dec., 1917. Effects of war on world's industry and industrial progress. Necessities revealed.
Birmingham Local Section: Chairman's Address (83615 N). Sydney T. Allen. 4000 w. Instn E E, Jl—Dec., 1917. Effects of the war and needed developments of electrical industries.
Western Local Section Chairman's Address (83612 N). R. Howard Fletcher. 2500 w. Instn E E, Jl—Dec., 1917. Problems arising from war necessities.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes
Aeroplane Construction in General (83493). Ottorino Pomilio. Ills. 2200 w. A A Wkly—Jan. 7, 1918. Serial, 1st part. Types and their construction.
Exploring and Mapping Jungle Lands by Aeroplane (83553 A). Russell Hastings Millward. Ills. 2200 w. Flying—Jan., 1918. Work of aviators after the war.
Some Notes on Recent German Aeroplanes (83389 A). Ills. 2000 w. Engr—Dec. 14, 1917. Information regarding certain types of captured machines exhibited in England.

Aircraft
The Aircraft-Problem (83332 A). W. F. Durand. 4000 w. A S M E, Jl—Jan., 1918. Problems in forming and maintaining a large and efficient air fleet.
The Amazing Development of Military Aeronautics in 1917 (83571). Henry Woodhouse. Ills. 2000 w. A A Wkly—Jan. 14, 1918. The importance of the air service.

Air Service
America's Air Service (83881 B). W. F. Durand. Ills. 26 pp. Fkn Inst, Jl—Jan., 1918. Account of the purposes of such a war measure and the requirements.
The War in the Air (83602 A). G. Douglas Wardrop. 2500 w. E Cb, Phila, Jl—Jan., 1918. What the Germans have accomplished and the problems to be solved.

Automotives
Automotives in the Great War (83700). Coker F. Clarkson. 3500 w. Am Mach—Jan., 24, 1918. Reviews the accomplishments during the past year.

Aviation
La Liason Aérienne Et La T. S. F. En Avion (83932 B). J. A. Lefranc. Ills. 2000 w. La Nature—Dec. 8, 1917. Aviation and radio operations by the Germans. Types of planes used, radio apparatus and fire control.

Aviators
Fighting Efficiency of American Aviators Can Be Quadrupled by Adoption of Walter Camp's Method of Training (83552 A). Henry Woodhouse. Ills. 1500 w. Flying—Jan., 1918. Value of training.
The Aviator, the Quarterback of War's Gridiron (83551 A). Walter Camp. Ills. 1800 w. Flying—Jan., 1918. Training to keep him in the physical, mental and nervous condition.

Ballooning
Free Ballooning (83554 A). F. P. Lahm. Ills. 1500 w. Flying—Jan., 1918. The care, equipment, management and usefulness.

Biplanes
The German Ago Fighting Biplane (83573). Ills. 3300 w. A A Wkly—Jan. 14, 1918. Detailed description.
The German A. E. G. Bombing Biplane (83492). Ills. 1800 w. A A Wkly—Jan. 7, 1918. Particulars of the 1917 type.

Engines
German Aeroplane Engines (83382 A). 1500 w. Engng—Dec. 14, 1917. Details of captured German aeroplanes and engines on exhibition at Islington, England.
British Aviation Engine Inspection (83562). R. K. Bagnall-Wild. Charts. 4000 w. Auto Ind—Jan. 10, 1918. Serial, 1st part. Chart scheme in use.
Overhauling the Gnome Airplane Engine (83348). Ills. 3500 w. Am Mach—Jan. 3, 1918. Instructions for disassembling and assembling.
The 160-Hp. Benz Aircraft Engine (83812 A). Ills. 1000 w. Auto Ind—Jan. 24, 1918. Design and performance data of one of Germany's leading aircraft engines.

Inclined Surfaces
The Influence of Aspect Ratio on the Critical Angle of Inclined Surfaces (83754 A). C. H. Powell. 500 w. Engng—Dec. 28, 1917. Investigations of value to aeroplane designers.

Model Experiments
The Wind Channel—Its Design and Use (83572). J. R. Pannell. Lecture before Aeronautical Soc. of Gt. Britain. 4000 w. A A Wkly—Jan. 14, 1918. Serial, 1st part. Value of model experiments, describing wind channels.

Naval Aircraft
Italian Naval Aircraft (83763 A). Ills. 700 w. Engr—Jan. 4, 1918. Details of a system of defence for the Adriatic, showing typical units.

Propellers
Automatic Airplane Propeller Shaping Machine (83753 A). Ills. 1200 w. Engng—Dec. 21, 1917. Detailed description of a British machine tool of interest.
Standard Hub for Airplane Propellers (83527). Fred H. Colvin. Ills. 500 w. Am Mach—Jan. 10, 1918. Details of hub adopted by the aviation section of the United States army.

War
War and Aeronautics (83806 A). William E. Beard. 5000 w. U S Nav Inst, Pro—Dec., 1917. The use of balloons in the Civil War.

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AUTOMOBILES

Annual Show
Mechanical Tendencies Revealed by the Show (83561). P. M. Heldt. Ills. 3500 w. Auto Ind—Jan. 10, 1918. Interesting developments seen at the New York show.

Axles
Design of Military Truck Axles (83703). G. W. Carlson. Ills. 2000 w. Auto Ind—Jan. 17, 1918. Engineering details of front and rear axles of Class B military worm-driven truck.

Automobiles
Efficient Transportation Demanded by Engineers (83304 A). J. Edward Schipper. 3000 w. Auto Ind—Jan. 3, 1918. (Special No.) Change of practice necessary to eliminate extravagance of wheel base and engine size.

Car Tooling
Tooling a Foreign Car in America (83419 A). Thomas Orchard. Ills. 1400 w. Machy—Jan., 1918. Serial, 1st part. Interesting jigs and fixtures used in tooling an automobile of foreign design.

Electric Vehicles
The Electric Vehicle for Handling Goods in the Works and on the Road (83370 N). Raymond J. Mitchell. Ills. 4000 w. Elec'n—Dec. 14, 1917. The scope of the electric vehicle, construction of chassis, etc.

Engines
Reasons Behind the Class B Engine (83702). A. F. Milbrath. Diagrams. 2500 w. Auto Ind—Jan. 17, 1918. Technical analysis of its design. Performance in tests.

Fuel
Fuel for Automotive Apparatus (83813 A). E. W. Dean. Read before S. A. E. 6000 w. Auto Ind—Jan. 24, 1918. Distillation curves of the different fuels and their adaptability to present-day engines.
Petrol's Part in the Great War (83747 A). Albert Lidgett. Ills. 2500 w. Autocar—Jan. 5, 1918. Shows the great part motor spirit plays.

Ignition
Spontaneous Ignition (83374 A). 1300 w. Autocar—Dec. 22, 1917. Explanation of the causes of knocking and how they may be overcome.

Manifolds
Modern Manifolds (83505 A). Ills. 1000 w. Auto Ind—Jan. 3, 1918. (Special No.) Study of the intake manifold and methods for preheating it.

Mobilization Depot
A Motor Transport Mobilization Depot (83352 A). Ills. 1800 w. Autocar—Dec. 15, 1917. A permanent camp for men, vehicles and stores for oversea service.

Motor Transport
Army Transportation (83331 A). L. B. Moody. Ills. 500 w. A S M E, Jl—Jan., 1918. The importance of motor equipment in the Ordnance Department.

Spark Plugs
Special Spark Plugs Needed for Airplane Engines (83508 A). Ills. 4000 w. Auto Ind—Jan. 3, 1918. (Special No.) Factors which determine the construction arc heat, oil conditions and gas tightness and insulation qualities under heat.

Starters
Impulse Starters for Tractors (83506 A). Ills. 1800 w. Auto Ind—Jan. 3, 1918. (Special No.) Enable a starting spark to be obtained without spinning engine.

Tractor Radiators
Tractor Radiators, Their Calculation and Design (83704). Arthur B. Modine. Diagrams. 2500 w. Auto Ind—Jan. 17, 1918. Portion of heat input compared with jacket losses.

Tractors
Rumely Adds Smaller Tractor Model (83811 A). Ills. 1800 w. Auto Ind—Jan. 24, 1918. Has a rating of 14-28 h.p.
Scotland Favors Light Farm Tractors (83507 A). 4000 w. Auto Ind—Jan. 3, 1918. (Special No.) More suitable for routine farm work.
An Agricultural Power Unit (83646 N). Alan E. L. Chorlton. Ills. 25 pp. Instn Aut Engrs—Dec., 1917. Serial, 1st part. Some factors governing the design of a small tractor.
Some British Agricultural Tractors and Haulers (83386 A). 3000 w. Engr—Dec. 14, 1917. Serial, 1st part. Progress in mechanical cultivation.

Truck Efficiency
Truck Efficiency Graphically Shown (83509 A). Francis W. Davis. 2000 w. Auto Ind—Jan. 3, 1918. (Special No.) Calculating truck's working capacity.

Truck Motor
Manufacturing Operations in Making a Gasoline Motor (83346). Ills. 1200 w. Am Machn—Jan. 3, 1918. Methods used in making and testing a four-cylinder truck motor.

Trucks
Freight Being Hauled Successfully Between New York and Philadelphia by Trucks (83677 A). Ills. 3000 w. Com Vhle—Jan. 15, 1918. 104-mile run daily on schedule time.
More Efficient Co-operation Delivery Demanded by War Conditions (83301 A). 3500 w. Com Vhle—Jan. 1, 1918. Shows that co-operative delivery by trucks cuts food costs and releases men for vital work.
Motor-Truck Transportation (83330 A). William P. Kennedy. 2500 w. A S M E, Jl—Jan., 1918. Developments to be expected to meet war necessities.
Three Class A 1½-Ton Q. M. C. Trucks Completed and on Way to Washington for Tests (83393 A). Ills. 1000 w. Com Vhle—Jan. 1, 1918. Characteristics.
War Conditions and Importance of Food Stuffs Forcing Farmers to Buy Trucks (83490 A). Ills. 3500 w. Com Vhle—Jan. 1, 1918. Labor shortage and railroad congestion help sales.

Wheels
The Hayter Road Wheel (83353 A). Ills. 1500 w. Autocar—Dec. 15, 1917. A construction which reduces the trouble of changing a pneumatic tire.
The Rapid Detachable Wheel (83746 A). Ills. 3000 w. Autocar—Jan. 5, 1918. Claims a locking mechanism enables a wheel to be detached or refitted in less than four seconds.

COMBUSTION MOTORS

Gas Engines
Gas Engine Troubles and Remedies (83829). A. L. Brennan, Jr. 1200 w. Power—Jan. 29, 1918. How to diagnose troubles and apply proper remedies.

HEATING AND COOLING

Air Conditioning
A Constant Temperature and Humidity Room for the Testing of Paper, Textiles, etc. (83608 B). F. P. Veitch and E. O. Reed. Ills. 4000 w. Jl Ind & Eng Chem—Jan., 1918. Control of humidity in industries.

Cantonments
For Soldiers in the Making (83669). Ills. 2500 w. Pr Pt Eng—Jan. 15, 1918. Refrigerating and ice making, water and heating plants installed at Rockford.

Cold Storage
Extra and Special Service by Cold Storage Warehouses (83576 A). F. M. Shoemaker. 2500 w. Ice & Refrig—Jan., 1918.
Multi-Stage Compression Plant of Central Cold Storage Co. (83583). Ills. 2500 w. Power—Jan. 15, 1918. Details of a modern two-unit ammonia plant of 500 tons refrigerating capacity employing new D. I. Davis system of multi-stage compression.
Science and the Cold Storage Industry (83432 A). W. Wemyss Anderson, with discussion. 5000 w. Roy Soc Arts, Jl—Dec. 21, 1917. Need of research work in England. Weak points and methods of strengthening them.

Drying
High Temperature Drying (83950 D). Burt S. Harrison. 14 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Evaporation; design of high temperature installation Air heating to high temperature.

Evaporation
The Temperature of Evaporation—Its Practical Application to Air Conditioning and to the Drying and Conditioning of Materials (83951 D). W. H. Carrier. 21 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Wet bulb temperatures and the laws governing it, giving formulae, and discussing its bearing on air conditioning.

Fuels
Utilizing the Heat in a Pound of Coal (83843). Harold L. Alt. 2000 w. Ht & Vtg Mag—Jan., 1918. Analysis of the relation between heating and mechanical equipment from fuel standpoint.

Gas Heating
Appareils, Système Ionidès, Pour Le Chauffage Au Gaz (83945 B). Ills. 1200 w. Le Genie Civil—Dec. 15, 1917. The Ionidès apparatus for gas furnaces, dryers, etc.

Heat Flow
A New Principle in the Flow of Heat (83883 B). Carl Hering. 2200 w. Fkn Inst, Jl—Jan., 1918. Research work.

Heating
Answering Fuel Needs with a New Heating System (83957 D). George S. Barrows. Ills. 14 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Details of the G. F. E. Sector system of gas heating.
What We Do and Don't Know About Heating (83954 D). John R. Allen. 2500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Heat laws; heat losses from buildings; infiltration; radiation, etc.

Hot Water
Relation of Hot Water Service Heating to Various Types of Buildings (83953 D). Harold L. Alt. 2500 w. Am Soc of Ht & Vt Engrs, Jl—Jan., 1918. Data of use in computing the amount required and steam or coal calculations.

Hot Water Pipe
The Preservation of Hot Water Supply Pipe in Theory and Practice (83952 D). F. N. Speller and R. G. Knowland. Ills. 3500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Principles of corrosion as applying to hot water supply systems.

Radiators
Report of Committee on Standard Method of Testing Radiators (83958 D). 1500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918.

Refrigeration
Overhauling an Atmospheric Ammonia Condenser (83671). A. G. Solomon. Ills. 2500 w. Pr Pt Eng—Jan. 15, 1918. Trouble due to coils made of pipe galvanized on inside as well as outside.
See also Thermodynamics, under MEASUREMENT.

HYDRAULIC MACHINERY

Pumping
Some Canadian Pumping Plants (83460). A. Huguenin. Ills. 3000 w. Can Engr—Jan. 3, 1918. Details of plants illustrating various installations.

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A Severe Test—A tile-surfaced Barrett Specification Roof being used as a Drill-Ground

Hundreds of marching feet—a regiment in action with a roof for its drill-ground—that's what you see above.

You couldn't use a roof much more severely than this.

And that's what happened almost daily for months on top of the big Altman Department Store in New York City, where several hundred members of the Home Defense League have learned to do their "bit."

Barrett Specification Roofs contain a larger amount of waterproofing and protective materials than any other roof-covering.

That is why they give such wonderful service.

And not only do they give longer service than any other type, but they *cost less per year of service.*

If you want this kind of a roof on your building, the way to make sure of getting it is to insert in your building plans the following:

> "The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall secure for me (or us) the 20-Year Guaranty Bond therein mentioned."

Only competent roofers can obtain the Bond, and the roof is constructed *under the supervision* of a Barrett inspector, who sees that the Specification is strictly followed.

20-Year Surety Bond

We now offer a 20-Year Surety Bond Guaranty on all Barrett Specification Roofs of fifty squares and over in all towns of 25,000 and over, and in smaller towns, where our Inspection Service is available.

Our only requirements are that The Barrett Specification of May 1, 1916, shall be strictly followed, and that the roofing contractor shall be approved by us.

A copy of The Barrett Specification with full information will be sent free on request. Address nearest office

Barrett Specification Waterproofing

The foundation of this huge structure is also kept dry with a great seal consisting of alternate layers of Specification Pitch and Felt. This is the standard type of waterproofing for all important underground construction.

Below is the Bond that guarantees your roof for 20 years.

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New York Chicago Philadelphia Boston St. Louis Cleveland
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Nashville Salt Lake City Seattle Peoria
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St. John, N. B. Halifax, N. S. Sydney, N. S.

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Pumps

The Application of Diaphragm Pumps to Metallurgical Work (83374 N). L. B. Eames. Ills. 1200 w. Chem, Met, & Min Soc of S Af, Jl—Oct., 1917. Its limitations and usefulness.

MACHINE ELEMENTS AND DESIGN

Bearings

Adjusting Marine Engine Bearings (83722). William M. McRobert. Ills. 1200 w. Power—Jan. 22, 1918. Suggestions for care of bearings.

Inventions

Inventions Relative to War Material (83901 A). W. Strother Smith. 6500 w. E Cb, Phila, Jl—Jan., 1918. Ways engineers can help in this field.

Machine Elements

Photo-Elasticity (83927). 1500 w. Times Engng Supp—Nov. 30, 1917. Optical method of studying elasticity and strain. Paper by E. G. Coker before Institution of Automobile Engineers.

MACHINE WORKS AND FOUNDRIES

Brass

Manufacture of Cartridge Brass in England (83781). 1000 w. Brs Wld—Jan., 1918. From paper by H. W. Brownsdon, read before Soc. of Chem. Ind., England. Conditions requiring closest attention to insure success.

Cannon

Cannon Making in Past Centuries (83663). H. H. Manchester. Ills. 1500 w. Am Mach—Jan. 17, 1918. Cannon manufacture between 1550 and 1800.

Castings

Casting Large Guns in the Early Eighties (83407). Job Goostray. Ills. 1500 w. Fndry—Jan., 1918. Difficulties encountered.

The Manufacture of Pattern Castings (83440 D). Henry M. Lane. Ills. 1500 w. Iron Age—Jan. 8, 1918. (Special No.) A new specialty foundry established by the Cope Pattern Works, of Detroit.

The Overweight Casting—Its Cause and Remedy (83409). R. R. Clarke. Ills. 7000 w. Fndry—Jan., 1918. Conservation of metal by proper molding.

Cores

How Cores Are Used to Cut Molding Costs (83405). Ills. 1500 w. Fndry—Jan., 1918. Account of large savings in molding by a more extensive use of cores.

Diamond Tools

Use of Diamond Tools in the Shop (83325). Frank A. Stanley. Ills. 2000 w. Am Mach—Jan. 10, 1918. Serial. 1st part. Classes of work for which they are adapted. Details of speeds, feeds and output.

Dies

Correcting Dies That Failed to Draw (83347). A. C. Lindholm. Ills. 1200 w. Am Mach—Jan. 3, 1918. How incorrectly designed dies were altered.

Die Work

Locating Small Holes Accurately in Die Work (83350). Hugo F. Pusep. 800 w. Am Mach—Jan. 3, 1918. Method for locating holes where it is impossible to use buttons.

Drawing

The Drawing-Office in Relation to Other Departments (83577 A). E. D. Roberts. Lecture to Jun. Instn. of Engr. 3500 w. Mech Wld—Dec. 21, 1918. Its relative position and importance.

Drilling

Modern Drilling Practice (83416 A). Edward K. Hammond. Ills. 10000 w. Machy—Jan., 1918. Basic principles to be obtained in the operation of drilling machines to secure maximum efficiency.

Economic Departments

See same heading under INDUSTRIAL MANAGEMENT, *Management*.

Electric Furnace

Harnessing the Electric Furnace to the Foundry (83408). Douglas Walker. Read before the Am. Fndry. Assn. 3000 w. Fndry—Jan., 1918. Progress showing merit of this electrical unit.

Forging

The Forging of an Off-Set Jaw (83064). J. V. Hunter. Ills. 2200 w. Am Mach—Jan. 31, 1918. Methods of casting and forging intricate parts.

Foundry Practice

Reminiscences of Early Steel Foundry Practice (83413). David McLain. Ills. 2500 w. Fndry—Jan., 1918. Read before Am. Fndry. Assn. Evolution of steel casting manufacture.

What Proper Routing Did for an Old Foundry (83415). H. E. Goetz, Ills. 1400 w. Fndry—Jan., 1918. Improvements resulting in greater efficiency.

Some Sand Mixing Methods (83780). C. Vickers. Ills. 1000 w. Brs Wld—Jan., 1918. Methods described.

Sweeping a Worm-wheel in Greensand (83692 A). James Edgar. Ills. 1000 w. Mech Wld—Dec. 28, 1917. Method suitable when there is no time to make a pattern.

Gas Furnaces

Gas Furnaces (83023). 1000 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by Arthur Forshaw, before Manchester Dist. Junior Gas Assn. Design and manipulation for various kinds of melting furnaces.

Gear Planers

The Sunderland Gear Planers (83378 A). Ills. & plates. 7000 w. Engng—Dec. 14, 1917. Explains principles governing the action.

High Temperatures

Dealing with Metals and Alloys Melting at High Temperatures (83578 A). Walter J. May. 1500 w. Mech Wld—Dec. 21, 1918. Suggestions for melting large quantities.

Interchangeability

Interchangeability, Tolerances and Finish (83791). J. P. Brophy. 2000 w. Am Mach—Jan. 24, 1918. Ideas as to requirements.

Lathes

Cincinnati Acme Universal Turret Lathe (83967). Ills. 1800 w. Am Mach—Jan. 31, 1918. Descriptive.

Details of 9-In. Center Heavy Duty Shell Lathe (83759 A). Ills. 500 w. Engng—Dec. 28, 1917. Describes a lathe built in Cincinnati, Ohio.

Machine Tools

After-War Prospects for American Machine Tools in France (83789). C. E. Carpenter. 2200 w. Am Mach—Jan. 24, 1918. Believes the demand will not decrease.

Machining

Machining Parts of a Calculating Machine (83667). Ills. 900 w. Am Mach—Jan. 17, 1918. Most parts described are made in punch presses from sheet metal. Test gages and press tools used.

Milling Machines

Plain Knee Type and Similar Milling Machines (83730 A). M. H. Williams. Ills. 7000 w. Ry Mech Engr—Jan., 1918. Their uses and possibilities in railway shops.

Patterns

Pattern for a Large Main Circulating Inlet Valve (83606 A). James Edgar. Ills. 1000 w. Mech Wld—Jan. 4, 1918. Directions for construction.

Precision Work

The Micrometer Head in Toolwork (83526). Hugo F. Pusep. Ills. 3000 w. Am Mach—Jan. 10, 1918. Methods.

Shell Tools

Boring and Reaming Tools for 220- and 270 m. m. French shells (83528). James Forrest. Ills. 1200 w. Am Mach—Jan. 10, 1918. Details of tools that have worked well.

Shop Practice

Correct Way of Making an Engine Piston Pattern (83412). Frank B. Raebig. Ills. 1500 w. Fndry—Jan., 1918. How to obtain economical results.

Manufacturing a Steel Chair (83664). G. F. Wetzel. Ills. 1500 w. Am Mach—Jan. 17, 1918. Methods of making an all-steel chair. Work on tubing and sheet metal.

Marking Off (83694 A). Joseph Horner. Ills. 1500 w. Mech Wld—Jan. 4, 1918. Serial. 1st part. Essential articles of the equipment, and methods used.

Operations in a Creamery Machinery Plant (83962). Frank A. Stanley. Ills. 2200 w. Am Mach—Jan. 31, 1918. Methods of coiling copper pipe on large modern drums, and of machining brass valves and plugs.

The Making of Plug and Ring Gages (83905). J. H. Smith. 2500 w. Am Mach—Jan. 31, 1918. Suggestions.

Springs

Laminated Steel-Spring Proportions (83963). H. H. Kennedy. 900 w. Am Mach—Jan. 31, 1918. Shows how various effects are secured.

Stoves

The Evolution of Cooking and Heating Stoves. (83410). Ills. 3000 w. Fndry—Jan., 1918. Early attempts in stove making.

Trade-Marks

Trade-Marks and the Manufacturer (83966). Glenn B. Harris. 2500 w. Am Mach—Jan. 31, 1918. Arguments in favor of trade-marks.

Typewriters

Making Typewriter Parts (83787). M. E. Hoag. Ills. 1000 w. Am Mach—Jan. 24, 1918. Serial. 1st part. Interesting milling and grinding fixtures are described in present number.

Welding

Comparison of Forge, Oxy-Acetylene and Electric Welding (83424 A). 1800 w. Machy—Jan., 1918. Essential factors in forge welding and their importance in the other processes.

Rehabilitating the Interned German Ships 83444 D). E. P. Jessop. Ills. 3000 w. Iron Age—Jan. 3, 1918. (Special No.) The part of electric welding in repairing the damaged ships—109 damaged vessels put in service in less than eight months.

Welding Transformer Tanks by Electric Arc Process (83417 A). Erik Oberg. Ills. 3000 w. Machy—Jan., 1918. Methods developed by the Pittsfield works of the General Electric Co.

MATERIALS OF CONSTRUCTION

Aluminum

L'Industrie Et Les Grandes Applications (83942 B). J. Escard. Ills. 5700 w. Le Genie Civil—Dec. 1, 1917. Industrial applications of aluminum and its various alloys.

Ferroalloys

Metallurgical Ferroalloys in 1917 (83862). Robert J. Anderson. 2500 w. Eng & Min J—Jan. 26, 1918. A review of the field.

Furnace Linings

Notes on the Disadvantages of Chrome Brick in Copper Reverberatory Furnaces (83873 D). Francis R. Pyne. 1000 w. A I M E—Dec., 1917. Points out disadvantages when treating materials too valuable to allow metal absorption.

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Inspection
Topical Discussions on the Subject of Inspection (83336 A). Papers by A. L. De Leeuw, F. A. Waldron, and B. W. Dunn, with discussion of all three. 11500 w. A S M E, Jl—Jan., 1918.

Molding Sand
Iron Oxide—Its Effect on Molding Sand (83406). W. R. Bean. Read before Am. Foundrymen's Assn. 1500 w. Foundry—Jan., 1918. Tests indicate that percentages over 3.5 per cent in sand are detrimental.

Muntz Metal
Typical Cases of the Deterioration of Muntz Metal (60:40 Brass) by Selective Corrosion (83961). Henry S. Rawdon. Illus. 15 pp. U S Bur Stnds. Tech paper 103—Dec. 15, 1917. Illustrated by four types, including tubings, sheets, and forgings.

Pig-Iron
Pig-Iron From Scrap-Steel (83320). Illus. 1200 w. Min and Sci Pr—Dec. 29, 1917. Synthetic pig-iron; production from scrap metal in the electric furnace.

Refractories
A Furnace for Testing Refractory Materials Under Load at High Temperatures (83594 A). Robert J. Montgomery. Illus. 1000 w. Met of Chem Eng—Jan. 1, 1918. A gas furnace which has been used successfully at the Koppers Co. laboratory.

Russian Timber
Les Richesses Forestières De La Russie (83906 B). C. Rabot. 1400 w. La Nature—Dec. 1, 1917. Estimate of the timber resources of Russia.

Screw Gages
Inspection of Screw Gages for Munitions of War (83423 A). Abstract of pamphlet by H. J. Bingham Powell. Illus. 5000 w. Machy—Jan., 1918. Measurement of pitch, and of full, effective, and core diameters.

Steel Plates
The Action of Caustic Liquors on Steel Plates (83394 A). C. E. Stromeyer. 2500 w. Engng—Dec. 14, 1917. Experiments showing the seriousness of the action of caustic soda.

Sulphuric Acid
The Sulphuric Acid Situation in the United States (83600 A). Lewis B. Skinner. 4500 w. Met of Chem Eng—Jan. 15, 1918. Information, including a discussion of the future of the industry.

MEASUREMENT

Differentiation
Mechanical Differentiation (83884 B). Armin Elmendorf. Illus. 2000 w. Frkn Inst, Jl—Jan., 1918.

Oil Tanks
Calculating the Contents of Oil Tanks (83723). R. T. Strohm. Illus. 1000 w. Power—Jan. 22, 1918. Methods of obtaining measurements.

Photo-Elasticity
See Machine Elements, under Machine Elements and Design.

Power Factor
Obtaining Power Factor by Use of Wattmeter (83686). E. G. Barrington. 1200 w. Elec Wld—Jan. 19, 1918. Explains manner in which power factor on three-phase circuits may be readily obtained.

Power Plants
Power Plan Calculations (83323). W. F. Schaphorst. 2500 w. Natl Engr—Jan., 1918. Chart for determining power of a steam turbine.

Pyrometers
Les Pyromètres Electriques Industriels (83905 B). E. Coustet. Illus. 1400 w. La Nature—Dec. 1, 1917. Design and use of various forms of electric pyrometers.

Pyrometers and Pyrometry (83690 A). 3500 w. Eng Rev—Dec. 15, 1917. Serial, 1st part. Problems and achievements of modern pyrometry.

Pyrometry
Uses of Pyrometry (83925). 2800 w. Times Engng Supp—Nov. 23, 1917. Temperature measurement in industry; value of scientific methods, automatic temperature control, etc.

Screw Threads
Measurement of Internal Threads (83421 A). William S. Rowell. Illus. 500 w. Machy—Jan., 1918. Recommends the use of an inside micrometer with ball points to assist in making and gaging internal threads.

Thread Milling (83420 A). Franklin D. Jones. Illus. 13700 w. Machy—Jan., 1918. Advantages of milling process; different methods of forming screw threads by milling; types and designs of milling machines.

Screw-Thread Tolerances for Munitions (83788). Illus. 700 w. Am Mach—Jan. 24, 1918. Tolerances of U. S. S. form of screw threads as established by U. S. Ordnance Dept.

Springs
Helical Spring Computations (83422 A). Donald H. Reeves. 5000 w. Machy—Jan., 1918. Charts for determining dimensions and properties of springs in tension and in compression.

Spur Gears
Pin Measurement of Spur Gears (83418 A). Reginald Trantschold. Illus. 2500 w. Machy—Jan., 1918. Principles governing measurement. Formulas.

Suspended Templets
Suspended Templets and Their Application (83584). Terrell Croft. Illus. 1500 w. Power—Jan. 15, 1918. Their advantages and use and various methods of suspending them.

Thermodynamics
How to Use a Psychrometric Chart (83844). J. I. Lyle. 2000 w. Ht & Vtg Mag—Jan., 1918. Ten typical examples and their solution, based on the Carrier psychrometric chart.

Torsion
The Use of Soap Films in Solving Torsion Problems (83638 A). A. A. Griffith and G. I. Taylor. Abstract of paper read before Inst. of Mech. Engrs. Illus. 3000 w. Engr—Dec. 21, 1917. Describes experimental method developed.

Weirs
Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings (83896 D). Floyd A. Nagler. Illus. 52 pp. A S C E, Pro—Jan., 1918. Results of 23 experiments on a standard Bazin weir. Methods of hydro-chemical and weir gauging used.

POWER AND TRANSMISSION

Air Pumps
Air Pumps (83760 A). Illus. 800 w. Engr—Dec. 28, 1917. Investigations on various methods of producing high vacuum.

Engines
The Centenary of the Heat Regenerator and the Stirling Air Engine (83388 A). Illus. 3000 w. Engr—Dec. 14, 1917. Specifications of Stirling's patent in 1816.

Lubrication
A Simple Problem in Forced Lubrication (83377 A). Lord Rayleigh. Illus. 700 w. Engng—Dec. 14, 1917. Maintaining the layer of lubricant between the opposed solid surfaces.

Economy in Lubricating Materials (83697 A). 1800 w. Mech Wld—Jan. 4, 1918. Serial. 1st part. Storing lubricants, lubricating devices, consumption, etc., are discussed.

Power
The Year's Progress in the Power Field (83400). Illus. 8500 w. Power—Jan. 1, 1918. A general review of important developments.

See same heading under INDUSTRIAL MANAGEMENT, *Regulation*.

Water Power
Engineering Council Urges Federal Water-Power Legislation (83743). 3000 w. Eng News-Rec—Jan. 24, 1918. From statement by Calvert Townley before the Water-Power committee of the U. S. Chamber of Commerce.

Notes on Water Supplies as Sources of Power (83374 A). Cecil H. Roberts. 2000 w. Surv'r—Dec. 14, 1917. Read before Instn. of Water Engrs. Wasted power; utilizing surplus water-power, etc.

STEAM ENGINEERING

Boilers
Boiler Management with Substitute Labor (83376 A). C. E. Stromeyer. 4000 w. Colly Gdn—Dec. 14, 1917. The problem of scarcity of labor and replacement by substitutes in the working of boilers.

Boiler-Room Efficiencies (83586). George F. Weaton, with discussion. Read before Engineers (R. I.) Eng. Soc. 4500 w. Power—Jan. 15, 1918. Suggested equipment for 1000-h.p. installation.

Determining Boiler Efficiency by Co_2 Analyses and Flue Temperatures (83512). Haylett O'Neill. Charts. 1800 w. Power—Jan. 8, 1918. How to obtain and use operating data by means of simple and cheap instruments.

New Method of Increasing the Evaporation in Boilers (83401). Carl Hering. 2000 w. Power—Jan. 1, 1918. A new thermal principle in water boiling.

Combustion
Automatic Combustion Control Saves Much Coal (83593). I. L. Kentish-Rankin. Illus. 1800 w. Elec Rev, Chi—Jan. 12, 1918. Saved 30 per cent. of coal bill in one hand-fired plant.

Smokeless Combustion of Coal (83699). Royce Peters. 3500 w. Pr Pt Eng—Jan. 15, 1918. Abstract of paper before the Smoke Prevention Assn. Fundamental conditions.

Condensers
Condensers (83427 B). Illus. 2000 w. Pwr Pt Eng—Jan. 1, 1918. Examples showing benefits of increased vacuum.

Condensers with Seventy-Foot Water Level Variation (83827). F. R. Brosius. Illus. 1200 w. Power—Jan. 29, 1918. Unusual type of construction to secure a supply of condensing water under unfavorable conditions.

Engines
Compound Steam Engines (83321). Carroll F. Merriam. 5000 w. Natl Engr—Jan., 1918. Advantages and limits of compounding and factors to be considered; the steam turbine and uniflow engine.

Notes on the Uniflow Steam Engine. (83375 A). A. G. T. Poole. Read before N. of Eng. Inst. of Min. & Mech. Engrs. Illus. 4500 w. Colly Gdn—Dec. 14, 1917. Method of working applications, types and tests.

Furnace Efficiency
Steam Boiler Furnace Efficiency (83322). S. S. Ledbetter. Illus. 3000 w. Natl Engr—Jan., 1918. Construction, operation and efficiency of powdered fuel plants.

Gas-Firing
Gas-Fired Boilers (83922). 1500 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by T. M. Hunter before Instn. Elect. Engrs. Best arrangement for different qualities of gas.

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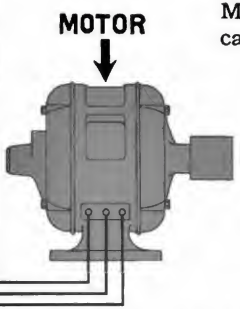
E.C.&M. AUTOMATIC COMPENSATOR

Push the Start Button

and the motor is automatically carried through the starting connection to the running connection without danger to the motor or to the load.

You can mount the E.C.&M. Automatic Compensator near the motor and run two small wires to the Push Button. The Push Button can be located at a point convenient to the operator.

More than one Push Button station can be installed if desired.



To stop the motor,

Push the Stop Button

WRITE FOR BULLETIN

THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, OHIO.
NEW YORK - 50 CHURCH ST.
PITTSBURG - OLIVER BLDG.
BIRMINGHAM - BROWN-MARX BLDG.
CHICAGO - 53 W. JACKSON BLVD.
DETROIT - DIME BANK BLDG.
TORONTO - TRADERS BANK BLDG.

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DIAMOND SOOT BLOWERS

"Cost More and Worth More"

The Metallurgical Engineer Says:

"One of the most interesting and worth-while achievements of the Research Laboratory of the General Electric Company at Schenectady has been its development of a process for impregnating iron and steel, with aluminum. The resulting material is a rich ferro-aluminum, of great hardness, possessing heat-resisting properties so great that it will outlast untreated iron and steel at high temperatures ten to twenty times or more. This new alloy, known as

INSULUMINUM

is produced at the Detroit plant of the Diamond Power Specialty Company for use in the construction of Diamond Soot Blower elements.

"In preparing the pipe on the table I allowed one-half to extend outside of the retort the other half being treated to form INSULUMINUM. The entire piece was then subjected to a test at 1410° Fahrenheit for thirty continuous hours. You see the results—the iron portion has oxidized badly, the INSULUMINUM portion is in as good condition as when the test began.

"In making service tests, INSULUMINUM soot blower units were placed at points in the boiler passes where the temperature ranged from 1600° to 2000° F. The need of blowers at these locations had long been recognized, but their application had been considered impracticable. Performances of the units were watched with keen interest for months. In the end it was proved that they met such hard service conditions fully. There was no sign of scaling or disintegration from the long exposure to combustion gases at the high temperatures obtaining.

"Durability is an essential requirement in a soot blower, and for this purpose no method of protection of the elements approaches INSULUMINUM in effectiveness.

"To you gentlemen, who are considering equipping every boiler in your plant with Diamond Soot Blowers, I want to say that you will find Diamonds employed in nearly every representative power plant in the country. Such industrial leaders as General Electric, Ford Motor, Youngstown Sheet and Tube, Solvay Process, Detroit Edison, Kansas City Railways, Brooklyn Edison, etc., have for some time confined their soot blower purchases to Diamond.

"I strongly recommend them to you."

Send for Bulletin 117. "Increasing Today's Profits"

Diamond Power Specialty Company, Detroit, Michigan

Sales and Service Branches in All Large Cities of the United States, Canada, Cuba and Hawaii

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Turbines

Blade Rings (83399 B). Ills. 2000 w. Pr Pt Eng—Jan. 1, 1918. Types and arrangements.

Governing of Turbines (83425) B). Ills. 1200 w. Pwr Pt Eng—Jan. 1, 1918. Classification of methods.

Steam Turbines (83394 B). Ills. 3000 w. Pwr Pt Eng—Jan. 1, 1918. Types and classification, characteristics, etc.

Turbine Blading (83398 B). Diagrams. 3000 w. Pwr Pt Eng—Jan. 1, 1918. Shape and dimensions for blading of reaction types.

Turbine Economy (83426 B). Chart and curves. 1500 w. Pwr Pt Eng—Jan. 1, 1918. Effects of variation in steam pressure, superheat, vacuum and size.

Turbine Nozzles (83397 B). Ills. 2000 w. Pwr Pt Eng—Jan. 1, 1918. Determination of proper sizes and shapes. Materials used.

Turbine Piping (83396 B). Ills. 1200 w. Pwr Pt Eng—Jan. 1, 1918. Piping layouts for various turbine systems.

Arrangement of Turbines (83395 B). Ills. 2500 w. Pwr Pt Eng—Jan. 1, 1918. Reasons for vertical, horizontal, single and double flow, bleeder, mixed pressure, exhaust and reversing turbines.

Turbines—Types, Operative, Installations and Care (83428 B). Ills. 28 pp. Pwr Pt Eng—Jan. 1, 1918. Details of many types.

TRANSPORTING AND CONVEYING

Ash Handling

The Pneumatic Disposal of Ashes from Power Houses by Means of Ropeways (83369 N). J. Wallwyn White. Ills. 3000 w. Elec'n—Dec. 14, 1917. (Special No.) Ropeway installations are described.

Cargo Crane

The Modern Cargo Crane (83362 N). Claude M. Toplis. Ills. 5500 w. Elec'n—Dec. 14, 1917. (Special No.) Relative advantages of the electric, steam and hydraulic types.

Charging Machines

Charging Machines (83365 N). Fred G. Smith. Ills. 1500 w. Elec'n—Dec. 14, 1917. Saving in labor.

Coal Handling

Transferring Coal from Railroad to Vessel (83545 A). Ills. 2000 w. Ry & Loc Eng—Jan., 1918. Recent developments in mechanical handling.

Conveyors and Elevators (83367 N). W. H. Atherton. Ills. 2500 w. Elec'n—Dec. 14, 1917. Serial. 1st part. (Special No.) Types for coal and ash.

Conveyors

Selection of Coal and Ash Conveyors (83585). H. E. Birch. Ills. 3500 w. Pwr—Jan. 15, 1918. Operation, maintenance, investment and adaptability.

Cranes

Giant Crane for the United States Navy (83666). W. H. Shepard. Ills. 1000 w. Am Mach—Jan. 17, 1918. Details, showing size and capacity.

Examples of Electrically-Driven Cranes (83359 N). H. H. Broughton. Ills. 3500 w. Elec'n—Dec. 14, 1917. (Special No.) Importance of using machinery in place of unskilled labor.

Electric Equipment

Notes on the Electric Equipment of Machinery for the Handling of Materials (83360 N). Ills. 2500 w. Elec'n—Dec. 14, 1917. Serial. 1st part. (Special No.) Details of electrical equipment.

Electric Trucks

Electric Industrial Trucks Help Reduce Present Serious Labor Shortage (83392 A). Ills. 1200 w. Com Vhle—Jan. 1, 1918. Their use in munition plants and factories.

Elevators

Operation and Maintenance of Elevators—Winding-Drum Machines (83510). R. H. Whitehead. Ills. 2200 w. Power—Jan. 8, 1918. Details of a modern winding-drum type elevator machine.

Handling Materials

Belt Shipping Plants (83355 N). F. G. Mitchell. Ills. 1300 w. Advantages of the belt-conveyor for the shipment of coal and ore. Plant at Durban.

Economic Transport and Its Influence on the Price of Everything (83358 N). Alfred Warwick Gattie. 2500 w. Elec'n—Dec. 14, 1917. (Special No.) Illustrates the importance of the cost of transport.

Electrical Machinery in Coke-Oven Works (83364 N). Alwyne Meade. Ills. 2500 w. Elec'n—Dec. 14, 1917. (Special No.) Types used, arrangement, and power required.

Grabs (83363 N). Ills. 1800 w. Elec'n—Dec. 14, 1917. (Special No.) Details of mechanical construction, describing the electric grab and system of control.

Lessons from America in the Handling of Coal and Iron Ore (83354 N). G. H. Hutchinson. Ills. 4500 w. Elec'n—Dec. 14, 1917. (Special No.) Methods developed in the Lake Superior region.

The Equipment of Railway Goods Stations with Electrical Machinery for Dealing with General Merchandise (83356 N). Roger T. Smith. Ills. 8000 w. Elec'n—Dec. 14, 1918. (Special No.) Considers electricity superior to any other motive power. Examples given.

The Present-Day Handling of Our Foodstuffs by Machinery (83357 N). Ills. 4500 w. Elec'n—Dec. 14, 1917. (Special No.) Examples of the conveyor applied to handling important foodstuffs.

Ore Loading

Iron Ore Loading Plant at Bilbao (83756 A). George Frederick Zimmer. Ills. 900 w. Engng—Dec. 28, 1917. Describes the unusual features of the plant.

Telphers

Telphers and Transporters (83368 N). George Frederick Zimmer. Ills. 6000 w. Elec'n—Dec. 14, 1917. (Special No.) Compares merits of telphers and conveyors; describes types of telphers in use and performance that may be expected.

MISCELLANY

Glycerine

La Fabrication De La Glycérine (83903 B). A. Breton. Ills. 1900 w. La Nature—Nov. 24, 1917. Popular description of methods and apparatus commonly employed for manufacture of glycerine.

ELECTRICAL ENGINEERING

COMMUNICATION

Interference

Final Report on Inductive Interference (83627 A). 2500 w. Tel Engr—Jan., 1918. Review of the work of the California Joint Committee.

Radiotelegraphy

Wireless Transmitting Stations on German Aeroplanes (83740 A). From La Nature. Elec Rev—Dec. 28, 1917. Brief description.

Rectifier

A rectifier for Telephone Use (83591). Ills. 1500 w. Telephony—Jan. 12, 1918. Details of Tungar rectifier and its operation.

Reis Telephone

Reis Telephone and Nature of Sound (83851). Articles by Arthur Bessey Smith and by J. G. Mitchell. 1800 w. Telephony—Jan. 26, 1918. Discussions of the "break and make" theory of the Reis telephone in regard to its relation to sound.

Research

Industrial Research with Some Notes Concerning Its Scope in the Bell Telephone System (83629 A). F. B. Jewett. 6000 w. Tel Engr—Jan., 1918. Read at Philadelphia meeting of the A. I. E. E.

Telephony

Some Recent Improvements in Telephony (83628 A). Ray H. Manson. Ills. 5000 w. Tel Engr—Jan., 1918. Review of progress. Read at Rochester meeting of A. I. E. E.

The Marvel of the Telephone (83630 A). J. F. Greenawalt. 3000 w. Tel Engr—Jan., 1918. Read at meeting of New Mexico Electrical Assn. The story of its invention and development.

ELECTRO-CHEMISTRY

Electrometallurgy

Electric Carbon Tool Steel (83769 A). John A. Holden. 2000 w. Ir & Cl Trds Rev—Dec. 28, 1917. Deals with the Heroult type of electric furnace for the production of tool steel.

La Récupération Du Cuivre Et De L'Acide Dans Les Vieux Bains De Décapage (83934 B). 1600 w. L'Industrie Electrique—Nov. 25, 1917. Electrolytic process for recovering copper and acid from old cleaning baths.

The Properties of Electrolytic Copper—Modulus of Elasticity (83616 N). B. Welbourn. 700 w. Instn E E, Jl—Dec., 1917. Results of investigation of the modulus which should be used for stranded conductors with Still's formula.

Galvano Work

Copper Galvano from Gutta Percha (83770). Joseph Haas, Jr. Ills. 1800 w. Brs Wld—Jan., 1918. Details.

Nickel Baths

The Preparation and Use of Rapid Nickel Baths (83411). E. P. Later. 3500 w. Fndry—Jan., 1918. Use of higher current densities, etc.

Nitrogen

Work of the British Nitrogen Products Committee (83599 A). 4500 w. Met & Chem Eng—Jan. 15, 1918. Preliminary report of plans under way for cyanamide, ammonia, oxidation, and experimental synthetic ammonia plants.

The Nitrogen Problem (83912). 1200 w. Nature—Dec. 6, 1917. Present status and outlook for the future among the allied nations.

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Steam
See same heading under Power Applications.

ELECTRO-PHYSICS

Electrons
The Electron Theory (83882 B). William Albert Noyes. Ills. 16 pp. Fkn Inst, Jl—Jan., 1918. Development of this theory.

Electrostatics
A Graphical Method for the Construction of Electrostatic Fields (83885 B). Sylvan J. Crooker. 700 w. Fkn Inst, Jl—Jan., 1918. Method explained.

Magnetism
The Influence of Magnetism on Light (83886 A). L. R. Ingersoll. 1500 w. Sci M—Jan., 1918. Results of investigations.

Radio-Activity
See Philippine Waters, under CIVIL ENGINEERING, Water Supply.

Silver Sulphide
Some Electrical Properties of Silver Sulphide (83654). George W. Vinal. Ills. 9 pp. U S Bur Stnds, Sci paper 310—Nov. 24, 1917. Investigations and results.

X-Rays
A New Radiator Type of Hot-cathode Roentgen-ray Tube (83610 A). W. D. Coolidge. Ills. 2500 w. Gen Elec Rev—Jan., 1918. Describes a tube developed for military use.
A Portable Roentgen-Ray Generating Outfit (83620 A). W. D. Coolidge and C. N. Moore. Ills. 4000 w. Gen Elec Rev—Jan., 1918. Outfit for military service in the field.

GENERATING STATIONS

Brown Coal
Electrical Energy from Brown Coal (83472 N). Map. 1000 w. Canwh Engr—Nov. 1, 1917. Investigations made for the Victorian government in regard to the commercial utilization of brown coal.

Central Stations
New Central Station of Union Gas & Electric Company at Cincinnati (83853). Ills. 4000 w. Elec Rev, Chi—Jan. 26, 1918. Interesting features of a large plant nearing completion.
The Central Station Industry in the War Period (83514). T. Commerford Martin. 1500 w. Elec Rev, Chi—Jan. 5, 1918. Gross earnings total $500,000,000; coal core-makers necessary rate increase.

Electric Power
Scottish Local Section: Chairman's Address (83614 N). Archibald Page. 5000 w. Instn E E, Jl—Dec., 1917. Supply of electric power in the United Kingdom; what has been accomplished in Scotland; and future possibilities.

Electric Service
Effects of War Conditions on Cost and Quality of Electric Service (83342 D). Lynn S. Goodman and William B. Jackson. 16 pp. A I E E, Pro —Jan., 1918. Considers the effects of war conditions as they apply to the electric light and power service of the country.
Spirit of War in the Central West (83479). Ills. 2500 w. Elec Wld—Jan. 5, 1918. Electric utilities mobilizing resources to meet service.

Equipment
Methods of Drying Out Flooded Plant Equipment (83511). Norman L. Rea. Ills. 2000 w. Power—Jan. 8, 1918. Good ways for drying out electrical equipment after a plant has been flooded.

Fuel Conservation
Electrical Interconnections to Conserve Fuel (83477). Maps. 1500 w. Elec Wld—Jan. 5, 1918. States of New York and California show results.

Hydro-Electric
Helping France to Help Herself (83687)! Alexander C. Clogher and Victor F. Hultner. Ills. 2000 w. Elec Wld—Jan. 19, 1918. Urges the development of hydro-electric power to supplant coal supply.
Notes on Water Supplies as Sources of Power (83699). Cecil A. Roberts. 2200 w. Can Engr—Jan. 17, 1918. From paper before Instn of Water Engrs. Its important place in future activities of the world and the problems to be solved.
Some Commercial Aspects of Hydro-electric Development (83853). Calvert Townley. 3000 w. Elec Rev, Chi—Jan. 26, 1918. Statement of present conditions; a comparison of steam-electric and hydroelectric plants.

Ireland
Dublin Local Section: Chairman's Address (83610 N). O. T. O'Kelly Webber. 1200 w. Instn E E, Jl—Dec., 1917. The resources of Ireland and their development.

Power Plants
Joliet Plant a Step Toward Higher Steam Pressures (83688). Ills. 1200 w. Elec Wld—Jan. 19, 1918. Serial, 1st part. Features of boilers, piping and economizers, with arrangements for handling coal and supplying feed water.
Power Plant Practice During 1917 (83516). I. L. Kentish-Rankin. Ills. 4500 w. Elec Rev, Chi—Jan. 5, 1918. Review of experiences due to shortage of coal and labor, and economies effected.
New High-Pressure Joliet Plant (83719). Ills. 3500 w. Power—Jan. 22, 1918. Interesting features of a new generating station in Illinois.

Service Cost
Effects of War Conditions on Cost and Quality of Electric Service (83709). L. S. Goodman and W. B. Jackson, with discussion 7800 w. Elec Rev, Chi—Jan. 19, 1918. Analysis of conditions in electric light and power service and some of their remedies. From paper before A. I. E. E.

GENERATORS AND MOTORS

Fires
Extinguishing Fires in Large Totally Enclosed Generators and Motors (83618 A). M. A. Savage. Ills. 1500 w. Gen Elec Rev—Jan., 1918. Recommends the use of steam for extinguishing fires in windings where the construction permits its application.
Fires in Turbo-Generators (83721). M. A. Walker. 1800 w. Power—Jan. 22, 1918. Possible means of combating these fires.

Generator Test
A Solution for an Acceptance-Test Problem (83685). W. B. Kouwenhoven. 1500 w. Elec Wld—Jan. 19, 1918. Simple method of correcting generator-unit load—characteristic curve for variations in speed.

Insurance
Insurance of Electrical Machinery (83737 A). C. Stuart Buyers. 1200 w. Elec Rev—Dec. 21, 1917. Serial, 1st part. Underlying principles of the usual methods of insuring electric plant.

Motor Control
The Control of Motors Operating Transportation Machinery (83361 N). T. G. Travis. Ills. 1500 w. Elec'n—Dec. 14, 1917. (Special No.) Contactor control, particularly switchgear for cranes, transporters, etc.

Rotor Cores
Design of Rotor Cores for Electrical Machines (83570). William Knight. 800 w. Elec Wld—Jan. 12, 1918. Development of formulas for figuring stresses in high-speed rotor-core punchings.

Voltages
Voltages of Magneto Generators (83708). T. J. Channing. Ills. 1200 w. Telephony—Jan. 19, 1918. Factors upon which voltage depends.

ILLUMINATION

Colliery Lighting
Economizing the Colliery Electric Lighting Supply (83770 A). L. Fokes. 2500 w. Ir & C. Tds Rev—Dec. 28, 1917. Ways in which colliery lighting supply can be economically utilized and the consumption reduced.

Factory Lighting
Factory Lighting Codes and Rules (83699 A). C. E. Clewell. Ills. 4000 w. Ind Man—Feb., 1918. Review of progress, and regulations of Wisconsin, New York, Pennsylvania and New Jersey.

Historical Lighting
The Historical Lighting of Independence Square, Philadelphia (83832 C). E. F. Kingsbury, with discussion. Ills. 15 pp. Ill Eng Soc, Trans—Dec. 31, 1917. Details of the new lighting recently installed.

Nomenclature
1917 Report of the Committee on Nomenclature and Standards of the Illuminating Engineering Society (83831 C). 10 pp. Ill Eng Soc, Trans—Dec. 31, 1917.

Progress
Lighting Progress for the Past Year (83515). H. W. Mateer. Ills. 1500 w. Elec Rev, Chi—Jan. 5, 1918. Progress in industrial and street lighting; development of Mazda motion-picture lamp.

Reflectors
Some Experiments on the Eye with Pendant Opaque Reflectors Differing in Lining, Dimensions, and Design (83833 C). C. E. Ferree and Gertrude Rand. Ills. 24 pp. Ill Eng Soc, Trans—Dec. 31, 1917. Investigates seven opaque reflectors.

War Lighting
Some Features of Special War Lighting (83517). Grable B. Weber. Ills. 800 w. Elec Rev, Chi—Jan. 5, 1918. Lighting of munition plants and training camps.

POWER APPLICATIONS

Cranes
Motors and Control for Traveling Cranes (83689). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 19, 1918. Eleventh article of a series on motor and control applications.

Electrical Apparatus
Development in Electrical Apparatus During 1917 (83519). 5000 w. Elec Rev, Chi—Jan. 5, 1918. Review of progress prepared by the Westinghouse Electric & Manufacturing Co.

Ice Plant
A Typical Motor-Driven Ice Plant (83854). Ills. 2500 w. Elec Rev, Chi—Jan. 26, 1918. Details of an electrically driven plant with central station supply.

Industrial Uses
Economic Industrial Applications of Electricity (83869 B). Norman T. Wilcox, with discussion. 13 pp. West Soc Engrs, Jl—Oct., 1917. Higher efficiencies possible through economic uses of electric service.

Lifting Magnets
Lifting Magnets (83366 N). Ills. 2500 w. Elec'n—Dec. 14, 1917. (Special No.) Operating costs, rating, control, etc.

Magnetic Pulleys
A Magnetic Steel Band Device (83693 A). F. L. Weston. Ills. 1200 w. Mech Wld—Dec. 28, 1917. From paper before Elec. Assn. of Aust. Experiments with magnetic pulleys and thin steel bands.

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Motor Drive

Fan, Blower and Air-Compressor Applications (83858). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 26, 1918. Twelfth article of a series. Operating characteristics of different types of apparatus for this service.

Motor Drive in the Preparation of Food (83582 A). Horace B. Smith. Ills. 2000 w. Elec Jl—Jan., 1918. Applications to coffee grinders, coffee roasters, meat choppers, meat slicing, ice cream freezers, churns, etc.

Planers

Operating Characteristics of Motor-Driven Planers (83569). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 12, 1918. Relative merits of non-reversing and reversing motor equipment for planers.

Pumping

Electric Pumping with Results of Tests and Operating Records (83643 N). H. W. Wagner. Ills. 75 pp. Iowa State College, Bul 46—Oct. 3, 1917. Equipment and operation, costs, results of tests, etc.

Rainfall

L'Emploi De L'Electricité pour La Production Des Pluies (83935 B). 3300 w. L'Industrie Electrique—Dec. 10, 1917. Experimental methods for production of rain by creating an electric field.

Ship Building

See same heading under MARINE AND NAVAL ENGINEERING.

Steam

La Production De La Vapeur Par L'Electricité (83907 B). H. Volta. Ills. 600 w. La Nature—Dec. 15, 1917. Steam generation by passing electric current through salt solution; the Revel system.

TRANSFORMERS

Testing

Simple Method of Testing Current Transformers (83708). 1200 w. Elec Rev, Chi—Jan. 19, 1918. Outline of tests by which laboratory equipment may be dispensed with.

TRANSMISSION AND DISTRIBUTION

Cables

Joint Boxes and Terminals for Split Conductor Cables (83741). Ills. 1200 w. Elec Rev—Jan. 4, 1918. Details of the Merz-Hunter protective system.

Frequencies

The Technical Story of the Frequencies (83341 D). B. G. Lamme. 1200 w. A I E E, Pro—Jan., 1918. Shows that the choice of frequency has mainly been based upon service conditions at the time.

Increased Loads

Adapting Existing Lines to Increased Loads (83481). Ills. E. B. Hook, Jr. 1500 w. Elec Wld—Jan. 5, 1918. Method of reinsulating line while alive; out-door substation built from equipment taken from other stations, etc.

Insulation

Electrical Properties of Vulcanized Fiber (83857). William Eves. 3d. 2000 w. Elec Wld—Jan. 26, 1918. Effect exerted by color, thickness and temperature on the breakdown value. Results of tests.

Secondary Networks

Successful Operation of Secondary Networks (83859). S. Bingham Hood. 2500 w. Elec Wld—Jan. 26, 1918. Discusses important points.

Short Circuits

The Suppression of Arcs Due to Accidental Grounds (83580 A). M. H. Colibohm. 3000 w. Elec Jl—Jan., 1918. Methods of providing for grounded circuit conditions; distinguishing features of these equipments.

Wiring

Best Practice in Service and Meter ing (83592). Edward B. Meyer. Ills. 2500 w. Elec Rev, Chi—Jan. 12, 1918. Precautions; advantages of full iron-clad wiring.

MISCELLANY

Electrcial Industry

Some Developments in the Electrical Industry During 1917 (83617 A). John Liston. Ills. 49 pp. Gen Elec Rev—Jan., 1918. Review of activities during the past year.

Electricity

Electrical Progress and Tendencies in 1917 (83513). Albert Scheible. 6500 w. Elec Rev, Chi—Jan. 5, 1918. Review of the year's advances.

Inst. E. E.

Inaugural Address (83609 N). C. H. Wordingham. 15000 w. Instn E E, Jl —Dec., 1917. How far the Institution meets the needs of the profession and industry and what improvements are possible.

CIVIL ENGINEERING

BRIDGES

Abutments

Turning Back Abutment Wing Walls Saves Material (83776). Charles K. Mohler. Ills. 2000 w. Eng News-Rec—Jan. 24, 1918. Revising layout of straight wall abutments.

Arches

Grandes Voutes (83944 B). A. Bonnet. Ills. 2400 w. Le Genie Civil—Dec. 15, 1917. Well known arches of long span, in different countries.

Concrete

Decision of U. S. District Court of Iowa on Certain Luten Patents for Concrete Bridges (83849). 2800 w. Eng & Con—Jan. 23, 1918. Extracts from opinion of Judge Martin J. Wade.

Mount Pleasant Road Bridge, Toronto (83587). J. S. Burgoyne. Ills. 3000 w. Can Engr—Jan. 10, 1918. Reinforced concrete structure consisting of a pair of cantilever beams of arched form with a free joint at center.

Erection

Problems and General Methods of Erecting the Scioto-ville Bridge (83529). Clyde B. Pyle. Ills. 4000 w. Eng News-Rec—Jan. 10, 1918. Serial, 1st part. Original plan, with elimination of secondary stresses, in placing large two-span continuous structure over the Ohio River.

Hardinge

The Hardinge Bridge at Sara (83928). Ills. 2400 w. Times Eng Supp—Nov. 30, 1917. New structure for railway over the Ganges river.

CONSTRUCTION

Beams

Design of Restrained Beams Carrying Hydrostatic Load (83700). E. H. Darling. Ills. 1000 w. Can Engr—Jan. 17, 1918. Diagrams and explanation.

Caissons

Land Big Drop Shaft on Seal and Curb Wall (83674). Ills. 1200 w. Eng News-Rec—Jan. 17, 1918. Fifteen-pocket concrete caisson sunk 100 feet.

Cantonments

The Solution of the Cantonment Construction Problem (83333 A). Leonard Metcalf. 4000 w. A S M E, Jl—Jan., 1918. Details of the work of the Cantonment Construction Division.

Concrete

Traveling Towers Place 92,000 Yards of Concrete (83532). Ills. 1000 w. Eng News-Rec—Jan. 10, 1918. Stationary measuring plants on large steel mill work cut labor costs.

Concrete Piles

Les Fondations En Terrains Compressibles (83908 B). M. Bousquet. Ills. 2300 w. La Nature—Dec. 29, 1917. The Frankignoul system of concrete piling for foundation work in soft ground.

Foundations

Foundations of the New Buildings of the Massachusetts Institute of Technology, Cambridge, Mass. (83898 B). Charles T. Main and H. E. Sawtell. Ills. 37 pp. Bos Soc C E,Jl—Jan., 1918. Describes geological conditions, foundations and reasons governing types used, tests, etc.

Housing

Industrial Housing (83603 A). H. W. Forster. 3500 w. E Cb Phila, Jl—Jan., 1918. Type of housing needed, and facts relating to the situation.

Lighthouses

Caissons and Cribs for Lighthouse Foundations (83535). Ills. 2000 w. Eng News-Rec—Jan. 10, 1918. Lights in Detroit River have concrete piers built in timber cribs or formed by concrete caissons sunk in place.

M. I. T. Buildings

Concrete Materials and Design of the New Buildings of the Massachusetts Institute of Technology, Cambridge, Mass. (83899 B). Sanford E. Thompson. Ills. 13 pp. Bos Soc C E, Jl—Jan., 1918. Engineering studies and investigations that determined the structural features of these concrete buildings.

Portable Houses

Portable Houses for Overseas Forces Built in Record Time by New Methods (83456). Ills. 2000 w. Eng News-Rec—Jan. 17, 1918. Good management giving unusual results.

Reinforced Concrete

Reinforced Concrete Constructions; Marriott System (83757 A). Ills. 1200 w. Engng—Dec. 28, 1917. Uses to which this system has been applied, particularly in railway structures.

The New Chicago Rules for Design of Reinforced Concrete Slab Floors (83846). 3000 w. Eng & Con—Jan. 23, 1918. New ruling that went into effect Jan. 1, 1918.

Tunnel Lining

Pneumatic Mixer Tram on Mount Royal Tunnel (83773). F. C. K. Stuart. Ills. 3500 w. Eng News-Rec—Jan. 24, 1918. Keeping machines close to forms found to give best results.

IRRIGATION AND RECLAMATION

Australia

Irrigation Scheme on the River Murray, South Australia (83766 A). Ills. 500 w. Engr—Jan. 4, 1918. Details of recently completed installation at Berri.

California

Irrigation Project Is Based on Economic Use of Water (83778). 2000 w. Eng News-Rec—Jan. 24, 1918. Limited supply necessitates high duty.

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Drainage
Durability of Cement Draintile and Concrete in Alkali Soils (83656 A). R. J. Wig, G. M. Williams, and A. N. Finn. Ills. 90 pp. U S Bur Stds, No. 95—Nov. 15, 1917. Investigations, tests, results and conclusions.

Run-Off from the Drained Prairie Lands of Southern Louisiana (83653 N). Charles W. Okey. 32 pp. U S Gov Print Office—Nov. 5, 1917. Investigations to establish the relation between the rainfall and amount of water necessary to pump to secure the growing of field crops.

Grading
Grading Land for Furrow Irrigation (83668 A). G. E. P. Smith. 2000 w. West Eng—Jan., 1918. Study of the relations between soil, slope, length of run, and unit head of water should be made.

Outlook
The Unprecedently Good Outlook for Irrigation in 1918 (83503 A). F. W. Park. Ills. 1500 w. Mun Eng—Jan., 1918. Increase in production due to irrigation, and the possibilities.

MATERIALS OF CONSTRUCTION

Cement
The Effect of Calcium Sulphate on Cement (83782 N). J. C. Witt and F. D. Reyes. 2000 w. Phil Jl Sci—May, 1917. Research work to determine the effect of various amounts of calcium sulphate on several cements.

Concrete
The Logical Proportioning of Concrete Aggregate (83803 A). Joel D. Justin. 17 pp. Corn C E—Dec., 1917. Explains a method of proportioning and its advantages and disadvantages.

Glass Sand
Optical Lens Manufacture Possible Using Glass Sand of West Virginia (83344 A). R. W. Stone. Ills. 2500 w. Mfrs Rec—Jan. 3, 1918. Analyses of glass sand from Berkeley Springs, W. Va.

Household Materials
Materials for the Household (83655 A). Ills. 245 pp. U S Bur Stds, Circ. 70—Dec. 5, 1917. Deseribes the more common materials, other than food and drugs, used in the home; their quality and use.

Reinforced Concrete
Effect of Fire on the Flat Slab Building of the Quaker Oats Co., Peterboro, Ont., Dec. 11, 1916 (83807 B). T. D. Mylrea, with discussion. Ills. 38 pp. West Soc Engrs, Jl—Oct., 1917. Studies the effect of the fire on this reinforced concrete flat slab construction.

Resources
Our Resources (83595 A). G. W. Thompson. 4500 w. Met & Chem Eng—Jan. 1, 1918. Presidential addresses delivered at the St. Louis meeting of Am. Inst. of Chem. Engrs. Ability to use material resources.

Sewer Pipe
The Supporting Strength of Sewer Pipe in Ditches and Methods of Testing Sewer Pipe in Laboratories to Determine Their Ordinary Supporting Strength (83642 N). A. Marston, W. J. Schlick, H. F. Clemmer. Ills. 56 pp. Iowa State College, Bul. 42—Oct. 10, 1917. Discussions, tests and conclusions.

MEASUREMENT

Flat Slab
Simple Formulas for Rapid Design and Estimates of Flat Slab Based on the Last Joint Committee Report on Concrete and Reinforced Concrete (83847). M. W. Serby. 700 w. Eng & Con—Jan. 23, 1918.

Graphics
Graphical Method of Finding Moments in Continuous Frames of a Girder and Two Fixed Columns (83845). W. S. Wolfe. Ills. 1500 w. Eng & Con—Jan. 26, 1918. Explains method of solving such problems.

Orifices
The Effect on Orifice and Weir Flow of Slight Roundings of the Upstream Edge (83804 A). Jacob O. Jones. Ills. 2200 w. Corn C E—Dec., 1917. This article gives investigations on orifices. Weir flow was dealt with in Nov. issue.

Survey Monuments
City Survey Monuments (83458). H. L. Seymour. Ills. 3500 w. Can Engr—Jan. 3, 1918. Reviews the practice of several Canadian cities.

Track Stresses
Progress Report of the Special Committee to Report on Stresses in Railroad Track (83897 D). Ills. 193 pp. A S C E, Pro—Jan., 1918.

MUNICIPAL

Activated Sludge
The Activated Sludge Experiments at Pasadena, Cal. (83524). Ills. 1500 w. Eng & Con—Jan. 9, 1918. Details of the plant and its operation.

Disinfecting
Combating Disease Organisms in Quarantine Stations and in Hospitals (83371 N). Henry A. Dixon. Ills. 2500 w. Comwh Engr—Nov. 1, 1917. Details of steam disinfecting apparatus.

Garbage
Utilization of City Garbage for Fuel Briquettes and Other Products (83345). William H. Ellis. 1200 w. Mfrs Rec—Jan. 3, 1918. Plans for the economic disposal of garbage.

Sanitation
Malaria Control Engineering in Texas Increases Labor Efficiency (83777). Charles Scoville and H. W. Van Hovenberg. Ills. 2200 w. Eng News-Rec—Jan. 24, 1918. Mosquito-prevention work along a large railroad.

Sanitary Work in the Army (83691 A). Arthur J. Martin. 7000 w. Surv'r—Dec. 21, 1917. Serial, 1st part. Public lecture in London. Details.

Sewers
Efficiency of Storm-Water Sewers Depends on Inlets (83534). Irving P. Kane. 1000 w. Eng News-Rec—Jan. 10, 1918. Type, location, and adjacent paving should suit conditions.

Street Cleaning
Sanitary Street Cleaning (83459). George A. Wiseman. Ills. 2500 w. Can Engr—Jan. 3, 1918. Reviews methods, favoring flushing.

Waste
Industrial Waste Problems with Reference to the Smaller Cities (83501 A). Langdon Pearse. 4500 w. Mun Eng—Jan., 1918. Sewage treatment, water supply, pollution, etc.

ROADS AND PAVEMENTS

Asphalt
Methods and Cost of Constructing Kentucky Rock Asphalt Road (83429). William S. Canning. Ills. 1200 w. Eng & Con—Jan. 2, 1918.

Stone-Filled Street Asphalt Suffers from Inattention to Detail (83672). Clifford Richardson. 1200 w. Eng News-Rec—Jan. 17, 1918. Uniform composition necessary. One and a half inches on a close binder is best.

Brick
Construction Plant and Methods Employed in Building South Meridian Monolithic Brick Road, Indianapolis, Ind. (83497 A). Maurice B. Greenough. Ills. 600 w. Mun Eng—Jan., 1918. Use of mechanical equipment in surfacing.

Concrete
A Concrete Roadway System in a Shop Yard (83540). Charles E. Parks. Ills. 2500 w. Ry Age—Jan. 10, 1918. Walks built by the Santa Fe in storehouse and shops at Topeka, Kan.

Concrete Roads as a Solution to Our National Transportation Problem; Their Construction, Maintenance and Development (83895 A). Clinton H. Fisk. 20 pp. E Cb St L, Jl—Nov.-Dec., 1917. The engineering possibilities of concrete as a road material.

Design and Construction of Concrete Roads in Wood County, W. Va. (83498 A). Burdette Woodyard. Ills. 1000 w. Mun Eng—Jan., 1918. Methods, materials, etc.

Concrete Pavements
Reinforcement for Concrete Pavements (83496 A). Ills. 1500 w. Mun Eng—Jan., 1918. Methods that have proved satisfactory.

Good Roads
Good Roads — a War Necessity (83575). George A. Ricker. 2500 w. Br Rds & Sts—Jan., 1918. Address at Toledo, O. Conditions making permanent roads necessary.

Real Motor Truck Roads and a Federal Statute Controlling Operation in Every State Are Now Necessary (83678 A). Windsor T. White. 3500 w. Com Vhle—Jan. 15, 1918. Important projects proposed.

Highways
The Construction and Maintenance of Highways Under War Conditions (83432). Arthur H. Blanchard. 2000 w. Eng & Con—Jan. 2, 1918. Factors that have retarded improvement.

Notes on Road Building in Washington's Time (83810 B). A. N. Johnson. 1500 w. West Soc Engrs, Jl—Oct., 1917. Information of interest.

Military Roads
Military Roads (83574). William D. Sohier. Address at Richmond, Va. 8500 w. Br Rds & Sts—Jan., 1918. Importance of stronger roads and their maintenance. Work in England, France and Italy.

Military Roads (83430). From address by William D. Sohier. 6500 w. Eng & Con—Jan. 2, 1918. Importance at the present time; roads in France; maintenance; road building in Italy, England and Wales.

Pavements
Present Status of Granite Block Pavements (83701). Clarence D. Pollock. 2200 w. Can Engr—Jan. 17, 1918. Abstract of paper read before Am. Assn. for Adv. of Science. The modern granite-block pavement.

Rattler Test
Rattler Test Called Unfair to Shallow Paving Brick (81531). William C. Perkins. 1500 w. Eng News-Rec—Jan. 10, 1918. Experience shows need of allowance to correct losses.

Repairs
Relative Efficiency in Methods of Repairs to Bituminous Macadam and Bituminous Concrete Pavements (83588). George H. Biles. Read before Am. Assn. for Adv. of Sci. 3000 w. Can Engr—Jan. 10, 1918. Saving methods.

Surfaces
Condition of Road Surface Outweighs Type of Bitumen (83533). 2200 w. Eng News-Rec—Jan. 10, 1918. Other details of secondary importance.

Recent Developments in the Design and Construction of Road Surfaces (83431). Abstract of paper by H. Eltinge Breed. 3000 w. Eng & Con—Jan. 2, 1918. Changes that will have the most influence on the development.

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WATER SUPPLY

Cantonmenta
Water Supply Specifications for National Army Cantonments Reviewed (83454). Dabney H. Maury. 2500 w. Eng News-Rec—Jan. 3, 1918. Attention given to quality, quantity and pressure.

Charges
The Basis of Water Charges in Urban Areas from the Point of View of Common Utility (83589). E. C. Rodda. Extracts from paper read before Munic W-Wks. Assn., at Birmingham, Eng. 2500 w. Can Engr—Jan. 10, 1918. Methods of raising revenue in certain communities.

Cleaning Mains
The Mechanical Cleaning of Water Mains in Rochester, N. Y. (83500 A). Edward H. Keith. Ills. 1500 w. Mun Eng—Jan., 1918. Details of work and advantages.

Concrete Pipe
Making and Placing Ten Miles of Concrete Pipe for Winnipeg Aqueduct (83673). K. B. Kumpe. Ills. 1800 w. Eng News-Rec—Jan. 17, 1918. Reinforced concrete dam dynamited under full head of water.
Floating-Crest Gates Used on Sherburne Lakes Dam (83676). Ills. 1200 w. Eng News-Rec—Jan. 17, 1918. Automatic movable crest, with radial top plate and cylindrical down-stream plate, devised for isolated site.

Mineral Springs
Mineral Springs of Canada. Part I. The Radioactivity of Some Canadian Mineral Springs (83652 N). John Satterly and R. T. Elworthy. Map & Ills. 23 Plates. 55 pp. Can Dept Mines—Bul. No. 16. Results of investigations.

Philippine Waters
The Radioactivity of Philippine Waters (83781 N). J. R. Wright and George W. Heise. Maps & Ills. 3000 w. Phil Jl Sci—May, 1917. Reports investigations of typical waters.

Purification
Combined Water Purification and Softening Plant of Great Falls, Mont. (83523). Ills. 2000 w. Eng & Con—Jan. 9, 1918. Features of plant that have given good results.
Design and Construction of the Water Purification and Softening Plant at Great Falls, Montana (83494 A). Robert E. McDonnell. Ills. 2500 w. Mun Eng—Jan., 1918. Descriptive.

Water Works
Practical Hints on Various Features of Water Works Design (83592 A). J. W. Ledoux. 6000 w. Mun Eng—Jan., 1918.

WATERWAYS AND HARBORS

Barge Canal
New York's New Canal Ready in 1918 (83493 A). M. E. Mutchler. Ills. 2000 w. Mar Rev—Jan., 1918. Engineering problems solved in its construction.

Copenhagen
Copenhagen's Free Port (83915). Julius Miertsch. Ills. 1500 w. Nautical Gazette—Jan. 3, 1918. Development of this port during last twenty-five years. Prospects for the future.

Dunkirk
Les Agrandissements Du Port De Dunkerque (83909 B). A. Breton. Ills. 1300 w. La Nature—Jan. 5, 1918. Harbor improvements and fortifications made at Dunkirk since war began.

France
Travaux D'Après-Guerre Dans Les Ports, Les Rivières Et Les Canaux (83941 B). P. Mallet. 4000 w. Le Génie Civil—Dec. 1, 1917. Serial, 1st part. Plans for work after the war on seaports, rivers and canals.

French Ports
Les Ports Français Et La Guerre (83939 B). A. Pawlowski. 5800 w. Le Génie Civil—Nov. 24, 1917. French ports and the war. Summary and conclusion of a series of articles on this subject published during the past year.

Ireland
Belfast Harbor (83920). 1600 w. Times Engng Supp—Nov. 30, 1917. New scheme for improvement and enlargement to accommodate increased traffic.

Lakes to Gulf
Imperative Need of the Lakes to the Gulf Deep Waterway (83495 A). H. B. Morgan. 1500 w. Mun Eng—Jan., 1918. Importance of connecting the Great Lakes with the Gulf of Mexico, through the Mississippi River.

Pacific Coast
The Neglected Waters of the Pacific Coast—Washington, Oregon, and California (83794 N). E. Lester Jones. Ills. & Maps. 16 pp. U S Dept Com—Special Pub. No. 48. Shows present-day conditions and the remedy.

Scotch Canals
Mid-Scotland Ship Canals (83637 A). Maps & Ills. 3000 w. Engr—Dec. 21, 1917. Serial, 1st part. The Loch Lomond scheme is discussed in the present article.

MARINE AND NAVAL ENGINEERING

Concrete Ships
Concrete for Ships (83918). A. T. Wall. 2000 w. Times Engng Supp—Nov. 30, 1917. Part I—Properties of the material.
Ferro-Concrete Shipbuilding in Norway (83556 A). Robert G. Skerrett. Ills. 1800 w. Int Mar Eng—Jan., 1918. Vessels built by the Fougner Steel-Concrete Shipbuilding Co., of Christiana.
Les Chalands Et Navires En Béton Armé (83040 B). Ills. 3800 w. Le Génie Civil—Dec. 1, 1917. Construction of barges and boats of reinforced concrete in Norway.

England
England's Ship Needs (83931). 2500 w. Nautical Gazette—Dec. 20, 1917. Abstract of recent debate in House of Commons. The "Standard" ship criticised.

Freighters
Results of Test on Bulk Freighter (83402 A). A. George Matteson and Thomas Durkin. Read before Soc. Nav. Archts. & Marine Engrs. Ills. 1500 w. Mar Rev—Jan., 1918.

Models
Cargo Ship Lines of Simple Form (83557 A). William McEntee. Ills. 800 w. Int Mar Eng—Jan., 1918. Results of tests of models.

Motorships
Shallow Draft Motorships for Use on the Volga River Designed by American Naval Architect for Russian Owners (83555 A). Ills. 700 w. Int Mar Eng—Jan., 1918. Oil tankers of 3500 tons carrying capacity, and cargo boats of 1500 tons capacity, limited to 7 feet and 5 feet draft respectively.

Pile Driving
Drive 15,000 Piles for Pair of Thousand-Foot Shipways (83453). Ills. 1200 w. Eng News-Rec—Jan. 3, 1918. Using machines with two-way motion rolling on finished rows.

Ship Building
Outlines of the Shipping Board Inquiry (83914). E. N. Hurley. 3400 w. Nautical Gazette—Dec. 27, 1917. Address to the Senate Investigating Committee. Ships contracted for. Review of work accomplished so far.
America's Great Shipbuilding Development (83435 D). C. E. Wright. Ills. 4500 w. Iron Age—Jan. 3, 1918. (Special No.) Progress made despite handicaps in getting plants ready.
Progress of Ship Construction at Emergency Fleet Yards (83848). 2000 w. Eng & Con—Jan. 23, 1918. Outlines progress in shipbuilding by Chairman Hurley of the Shipping Board.
Over $400,000,000 for Steel and Wooden Ships Now Building in South (83560). Ills. 12 pp. Mfrs Rec—Jan. 10, 1918. Summary of shipbuilding activities along the South Atlantic and Gulf coast.
Shipbuilding Expedited by Electric Service (83482). David Elwell. Ills. 3000 w. Elec Wld—Jan. 5, 1918. Power requirements and details of electrical distributing system for Staten Island Shipbuilding Co.

Shipping
Our Transport Problem (83913). Irving T. Bush. 2200 w. Nautical Gazette—Dec. 13, 1917. Address to N. Y. Chamber of Commerce explaining the ocean transport problem of the U. S.

Ships
1917 and the Question of Ships (83765). With editorial. 4500 w. Engr—Jan. 4, 1918. Effects of submarine warfare; the pressing need of ships.

Shipyards
Report of the Shipyard Employment Managers' Conference (83644 N). 60 pp. U S Gov Print Office—1918. Report of conference held under the auspices of the industrial service department of the division of construction.
Three Government Shipyards Huge Problem in Plant Layout (83450). Ills. 5500 w. Eng News-Rec—Jan. 3, 1918. Design of government plants for building fabricated steel ships.

Submarine Chasers
Italian Submarine Chasers (83761 A). Ills. 300 w. Engr—Dec. 28, 1917.

Submarines
La Défense Du Commerce Maritime (83946 B). 4700 w. Le Génie Civil—Dec. 15, 1917. Serial, 1st part. Progress in defense of the merchant marine.
Une Demi-Année De Guerre Sous-Marine (83900 B). Ills. 2300 w. La Nature—Nov. 17, 1917. Charted records of sinkings, unsuccessful attacks and losses of both neutrals and allies.

Torpedoes
Les Modèles Actuels De Torpilles Automobiles (83943 B). M. Stroh. Ills. 6200 w. Le Génie Civil—Dec. 8, 1917. Interior mechanism and apparatus of several types of torpedo.

Wooden Vessels
Anyox—A New Wooden Ore Carrier (83404 A). Robert C. Hill. Ills. 2000 w. Mar Rev—Jan., 1918. Details of a recently completed steamer.

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MINING AND METALLURGY

BASE METALLURGY

Arizona

The Story of the U. V. X. Bonanza (83487). T. A. Rickard. Ills. & Maps. 5000 w. Min & Sci Pr—Jan. 5, 1918. Serial, 1st part. History of a long and discouraging development of copper mines splendidly vindicated.

Copper

Ajo Copper Mine (83878). Courtenay De Kalb. Ills. 3000 w. Min & Sci Pr—Jan. 26, 1918. Serial, 1st part. Production: history of development; geology, etc.

Andes Copper Mining Co.'s Development at Potrerillos, Chile (83733). James E. Harding. Ills. 1200 w. Eng & Min Jl—Jan. 19, 1918. At an expense of $5,000,000 a deposit of 1.4 per cent. copper ore, estimated at 100,000,000 tons, will be exploited by Anaconda.

Progress in Metallurgy of Copper (83736 A). H. C. H. Carpenter. 7500 w. Roy Soc Arts, Jl—Jan. 4, 1918. Serial, 1st part. History of the copper production and the reversal of the output; describes the Welsh process of copper smelting and refining; and outlines best modern practice in United States.

Some Notes on the Copper Deposits of the Northern Interior of British Columbia (83892 X). John D. Galloway. 2000 w. Can Min Inst, Bul—Jan., 1918. Promising properties and their development.

The Bogomolovsky Copper Mines, Russia (83724). N. T. Truschkoff. Ills & Map. 1500 w. Min & Sci Pr—Jan. 19, 1918. Characteristics of mines; a great pyrite belt; geology; development; costs.

The Lake Superior Copper Country (83822). Homer Guck. Ills. 1500 w. Min & Sci Pr—Jan. 12, 1918. Story of the Calumet & Hecla development.

Zinc

Joplin and the Kornspelter Region (83901). Otto Ruhl. 1500 w. Min & Sci Pr—Jan. 5, 1918. Depression in the zinc industry.

The Wisconsin Zinc District (83877 D). H. C. George. Ills. 30 pp. A I M E—Dec., 1917. Mines, scattered deposits. production, etc.

COAL AND COKE

Anthracite

Anthracite Industry in 1917 (83712). Edward W. Parker. 3000 w. Cl Age—Jan. 19, 1918. Important features of the anthracite industry during the year.

Anthracite in New England in 1917 (83714). G. G. Wolkins. 1200 w. Cl Age—Jan. 19, 1918. Slow and inadequate deliveries. Increased costs.

Mining anthracite in the Pennsylvania Wyoming Region in 1917 (83825). J. H. Haertter. 1200 w. Cl Age—Jan. 26, 1918. Production, methods, electric locomotives.

Résume of the Anthracite Industry in 1917 (83823). H. M. Crankshaw. Ills. 1000 w. Cl Age—Jan. 26, 1918. Methods adopted to increase production.

Briquettes

A Modern Belgian Briquette Factory, with the "Cava" Pitch Process (83750 A). E. Gevers-Orban. Ills 1600 w. Colly Gdn—Dec. 28, 1917. Details of factory and methods.

Briquetting

Briquetting of Anthracite Coal (83865 D). W. P. Frey. Ills. 2000 w. A I M E, Bul—Jan., 1918. Explains how success has been attained.

Brown Coal

See same heading under ELECTRICAL ENGINEERING, *Generating Stations.*

Coal Conservation

Interim Report of the Coal Conservation Sub-Committee of the Reconstruction Committee (83743 A). Abstract, with editorial. 1000 w. Elec'n—Dec. 28, 1917. Report on electric power supply in Great Britain. Waste of coal.

Coal Problem

Corrective Steps for Our Coal Problem (83850). Ills. 2000 w. Elec Wld—Jan. 26, 1918. Serial, 1st part. Critical question of coal supply and cost; suggestions.

Review of the Coal Situation of the World (83864 D). George S. Rice. 5500 w. A I M E, Bul—Jan., 1918. The resources, production, consumption, exports and imports, etc.

Coal Saving

A Talk to Firemen on Saving Coal (83828). Charles H. Bromley. 2500 w. Power—Jan. 29, 1918. From lecture at Baltimore. Most important way of getting the most out of coal.

Coal Shortage

Facing the Fact of Coal Shortage (83684). 1500 w. Elec Wld—Jan. 19, 1918. Conditions of supply serious for central stations.

Why and Wherefore of the Coal Shortage (83476). J. D. A. Morrow. 2800 w. Cl Age—Jan. 5, 1918. Lack of transportation the primary cause. Also discusses features of the situation.

Coal Trade

Market Conditions in New England in 1917 (83822). G. G. Wolkins. 6000 w. Cl Age—Jan. 26, 1918. Reviews the general features affecting the coal trade.

Philadelphia Coal Trade in 1917 (83717). W. D. Hammer. 5000 w. Cl Age—Jan. 19, 1918. Demands not satisfied and margins of profits small.

St. Louis Coal Trade in 1917 (83811). E. J. Wallace. 2500 w. Cl Age—Jan. 26, 1918. Review.

The Coal Trade of 1917 (83751 A). 29500 w. Colly Gdn—Jan. 4, 1918. Review by districts and by methods of trade in Great Britain.

The New York Coal Trade in 1917 (83716). R. W. Morris. 3500 w. Cl Age—Jan. 19, 1918. Many hardships, uncertainties and disappointments. Bunker coal very scarce.

The 1917 Coal Trade of the Northwest (83713). W. B. Kidston. 3500 w. Cl Age—Jan. 19, 1918. Active year—the supply seldom meeting the demand.

Coal Waste

The Use of Culm and Other Waste Materials from Coal-Washing Plants for Other Purposes (83566 A). John B. C. Kershaw. 4000 w. Met & Chem Eng—Jan. 1, 1918. Reviews progress in utilization of low-grade fuels for power purposes.

Coke-Ovens

Power Plant Installations for By-product Coke Oven Plants (83804 A). George B. Evans. 2500 w. E Cb St L, Jl—Nov.-Dec., 1917. Describes installation in St. Louis plant.

Saline Corrosion of Coke Oven Walls (83749 A). H. Schwenke, in *Glückauf.* Ills. 1500 w. Colly Gdn—Dec. 28, 1917. Methods of prolonging the life of oven linings, and repairing them.

Constituents

The Oxidizable Constituents of Coal (83841 X). J. Ivon Graham and James Hill, with discussion. Ills. 27 pp. Instn Min Engrs, Trans—Dec., 1917. Investigations.

Fuel

Coaling Plants and Fuel (83340 A). W. T. Kransch, with discussion. 9500 w. West Ry Cb, Pro—Nov. 19, 1917. Main features controlling design of plants, fuel economy, etc.

Fuel Conservation (83955 D). I. Economy in Fuel. Perry West. II. Conservation of Fuel. William M. MacKay. 2000 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Ways and means of conserving the coal supply.

Fuel Consumption Control by the Government (83729). J. W. Henderson. 4000 w. Power—Jan. 22, 1918. Proposes that the government assume absolute control of coal and its distribution and consumption.

Output and Value of Fuel in 1916 (83752 A). 1500 w. Colly Gdn—Jan. 4, 1918. From general report on mines and quarries, edited by W. Walker.

The Fuel Problem (83329 A). L. P. Breckenridge. 1200 w. A S M E, Jl—Jan., 1918. Coal production, distribution and use.

Fuel Conservation

Bonus System for the Saving of Coal (83480). Walter N. Polakov. 3000 w. Elec Wld—Jan. 5, 1918. Task-setting plan results in increased economy.

Fuel Conservation (83926). 2000 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by J. B. C. Kershaw before Liverpool Engng Soc. Use of low-grade fuels, such as coke-breeze, culm, etc.

Fuel Economy

Work of the New Orleans Fuel Administration Committee (83830). Leo S. Weil. 2000 w. Power—Jan. 29, 1918. Work to conserve the coal supply.

The New Haven Saves a Million Dollars in Fuel (83817). From a report by George W. Wilder. 1800 w. Ry Age—Jan. 25, 1918. Marked economies effected by supervision of locomotives.

Illinois

Southern Illinois in 1917 (83715). E. J. Wallace. 3000 w. Cl Age—Jan. 19, 1918. In spite of many labor troubles the year was prosperous.

Lignites

Carbonizing and Briquetting of Lignites (83959 X). W. J. Diek. 20 pp. Com of Conservation, Canada—1917. The economic possibilities.

Middle West

Market Conditions in Middle West in 1917 (83718). O. M. Burnett. 3000 w. Cl Age—Jan. 19, 1918. Continuous coal shortage; labor troubles; inadequate transportation, etc.

Mine Engineering

Efficiency Engineering for Coal Mines (83567). C. H. Elsom. 3500 w. Cl Age—Jan. 12, 1918. Value of specialization in engineering.

Mine Power

An Up-to-Date Coal Mine Power Plant (83566). Dever C. Ashmead. Ills. 2000 w. Cl Age—Jan. 12, 1918. Serial, 1st part. Details of construction of a new plant at Clymer, Penn.

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Mining Methods
The Working of Seams Having Frail Roofs (83768 A). John W. Case. Ills. 3000 w. Ir & Cl Trds Rev—Dec. 28, 1917. Timbering and best methods are discussed.

Production
Activities in Different Coal-Producing States in 1917 (83711). 20 pp. Cl Age—Jan. 19, 1918. Coal-mine inspectors reports of the various states.

Safety Lamps
Lighting Safety Lamps by Electrical Ignition (83748 A). L. Fokes. Ills. 2500 w. Colly Gdn—Dec. 21, 1917. Details of accumulators and sparking coil method, and of the magneto-generator lighters.

Sampling
Directions for Sampling Coal for Shipment or Delivery (83647). George S. Pope. Ills. 10 pp. U S Bur Mines—Tech paper 133. Instructions regarding hand methods of sampling in the field.

Signaling
Block Signal System for Coal Mines (83588). Frank Huskinson. Ills. 2000 w. Cl Age—Jan. 12, 1918. Details of the automatic system and its advantages.

Spontaneous Ignition
Coal Stack Fire Risks (83739 A). E. B. Pansey. 3000 w. Elec Rev—Dec. 28, 1917. Dangers from spontaneous ignition, the causes, and means of storing coal with a minimum of danger.

Storage
Anthracite and Bituminous Coal Storage (83475). Horace Goldstein. Ills. 2000 w. Cl Age—Jan. 5, 1918. Tells how and where to stock the two kinds of fuel.

Testing
Some Notes on Coal Testing (83742 A). G. W. Stubbings. 2000 w. Elec Rev—Jan. 4, 1918. Directions for sampling and determining the calorific value.

Utah
Coal Mining in Utah in 1917 (83820). A. C. Watts. Ills. 6000 w. Cl Age—Jan. 26, 1918. Reviews this industry for the year.

GEOLOGY

Antarctic
Antarctic Geology (83834 A). Griffith Taylor. Map & Ills. 5500 w. Min Mag—Dec., 1917. Deseribes geology of part of South Victoria Land and gives information relating to coal deposits.

Oklahoma
Geologic Structure in the Cushing Oil and Gas Field, Oklahoma (83640 N). Carl H. Beal. Ills. & Maps. 55 pp. U S Geol Surv—Bul 638. Aims at preventing economic waste in the production of oil.

Ore Deposits
Pressure in the Formation of Ore Deposits (83880). Stephen Taber. Ills. 2500 w. Min & Sci Pr—Jan. 26, 1918. Crystal pressure in forming vein-space in deposition of minerals.

IRON AND STEEL

Blast Furnaces
Slag Viscosity Tables for Blast Furnace Work (83876 D). A. L. Field and P. H. Royster. Abstract of Tech. paper 187 of U S Bur Mines. 2000 w. A I M E—Dec., 1917. Purpose and scope of slag viscosity tables, their use, etc.
Temperature-Viseosity Relations in the Ternary System CaO-Al$_2$O$_3$-SiO$_2$ (83875 D). A. L. Field and P. H. Royster. Abstract of Tech. paper 189, of U. S. Bur. of Mines. 2500 w. A I M E—Dec., 1917 General features of experimental work and conelusions.

Construction
New Iron and Steel Works Construction (83449 D). 12 pp. Iron Age—Jan. 3, 1918. (Special No.) Open-hearth steel capacity completed last year 4,326,500 tons—that now building represents 1,645,000 tons.

Electric Furnaces
The Booth-Hall Electric Steel Furnace (83443 D). Ills. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) New type operating at the plant of the Midland Electric Steel Co., Terre Haute, Ind.

Electrometallurgy
The Status of the Electric Steel Industry (83448 D). 2500 w. Iron Age—Jan. 3, 1918. (Special No.) Progress since 1910. United States foremost in output.

Engineering Industries
The Iron, Steel, and Engineering Industries in 1917 (83762 A). 5000 w. Engr—Jan. 4, 1918. Serial, 1st part. Annual review of industries in Great Britain.

Fuel-Saving
Newcastle Local Station: Chairman's Address (83611 N). A. H. W. Marshall. 5800 w. Instn E E, Jl—Dec., 1917. Electricity, and its bearing on fuel-saving in the iron and steel trades.

Iron Ore
Shortage of Supply of Non-Phosphoric Iron Ore (83910). W. G. Fearnsides. Ills. 2000 w. Nature—Nov. 22, 1917. Abstract of Howard Leetures before Royal Society of Arts.

Iron Trade
Reviews of Iron, Steel and Other Metals in 1917 (83446 D). 18 pp. Iron Age—Jan. 3, 1918. (Special No.) Reviews by different writers of the develoPments in important markets. Production, prices, wages, etc.
British Iron and Steel Trades in 1917 (83537 A). L. H. Quin. 1800 w. Iron Age—Jan. 10, 1918. Strictest government control throughout the year.
The Iron and Steel Trade in 1917 (83772 A). 4500 w. N & Cl Trds Rev—Jan. 4, 1918. District reviews.

Manganese
The Determination of Manganese in Steel in the Presence of Chromium and Vanadium by Electrometric Titration (83607 B). G. L. Kelley, M. G. Spencer, C. B. Illingworth, and T. Gray. 4000 w. Jl Ind & Eng Chem—Jan., 1918. Shows a method that does not require special skill.

Metallurgy
Phases of Iron and Steel Metallurgy in 1917 (83447 D). J. E. Johnson, Jr. 7000 w. Iron Age—Jan. 3, 1918. Special No.) Operating difficulties were a spur to new methods.

New Plant
New Steel and Wire Plant (83442 D). Ills. 1800 w. Iron Age—Jan. 3, 1918. (Special No.) Plant of Keystone Steel & Wire Co., near Peoria, Ill.

Pig Iron
The Cost of Electric Pig Iron Production in North Sweden (83379 A). 2000 w. Engng—Dec. 14, 1917. Considers the fuel for the reduction of the ore, the ore, and the power.

Plate Mill
Build Hundred and Ten Inch Plate Mill in Six Months (83451). Ills. 2000 w. Eng News-Rec—Jan. 3, 1918. Details of construction of "Liberty Mill" at the Homestead Works, explaining conditions.
The Liberty Mill (83550 A). Ills. 200 w. Int Mar Engr—Jan., 1918. 110-inch plate mill for rolling ship plates for emergency fleet.
The Liberty Mill of the Carnegie Steel Co. (83436 D). Ills. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) A 16000-ton monthly capacity plate mill built in six months at Munhall, Pa.

Spiegeleisen
Spiegeleisen in Place of Ferromanganese (83441 D). Edwin F. Cone. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) Experience of some American steel makers.

Steel
The Effect of the Presence of a Small Amount of Copper in Medium-carbon Steel (83867 D). Carle R. Hayward, and Arch B. Johnston. 1800 w. A I M E, Bul—Jan., 1918. Investigation to obtain data on the mechanical properties.

Sudbury Ores
Nickel-Copper Steel Direct from Ludbury Ores (83623). F. H. Mason. 1200 w. Min & Sci Pr—Jan. 12, 1918. Analyses of ore and steels; methods and tests.

Tin Plate
The Manufacture of Tin Plate (83439 D). Clement F. Pappleton. Ills. 6500 w. Iron Age—Jan. 3, 1918. (Special No.) Equipment of the modern plant.

MINE OPERATION

Asbestos
Asbestos Mining in Tasmania (83631 A). Hartwell Conder. Ills. 2000 w. Aust Min Stand—Dec. 6, 1917. Describes this industry and the outlook.

Butte
Mining at Butte (83488). Ben F. Evans. Ills. 2200 w. Min & Sci Pr—Jan. 5, 1918. Labor troubles; November output of the Anaconda; influence of prices of copper and silver.

Chronology
Mining Chronology of 1917 (83824). R. Dawson Hall. 2500 w. Cl Age—Jan. 26, 1918. Important events.

Drill Bits
Relative Merits of Carr and Cross Bits as Disclosed by Drilling Tests (83861). 700 w. Eng & Min Jl—Jan. 26, 1918. Reviews development of various classes of bits and conditions under which special types may be employed.

Elevators
Otis Passenger Elevator at Inspiration Shaft (83874 D). C. E. Arnold. Ills. 1200 w. A I M E—Dec., 1917. Amplifies deseription given by H. Kenyon Burch in a reeent paper.

Fires
Measures for Controlling Fires at the Copper Queen Mine (83868 D). Gerald Sherman. Ills. 1200 w. A I M E, Bul—Jan., 1918. Notes on preparations to eheck fire and facilitate the eseape of workmen.

Gasoline Engines
Suggestions for the Safe Operation of Gasoline Engines in Mines (83648). R. H. Kudlich and Edwin Higgins. Ills. 15 pp. U S Bur Mines—Tech paper 174. Deals especially with preeautions that should be taken to prevent mine fires or explosions, or air pollution.

Hydraulic Mining
Syphoning Gravel (83839 N). J. Jervis Garrod. Ills. 2000 w. Instn Min & Met, Bul. 159—Dec. 13, 1917. Method of hydraulicking and elevating by means of a syphon.

Methods
American Notes (83842 N). Samuel Dean, with discussion. 27 pp. Instn Min Engrs, Trans—Dec., 1917. Methods of increasing production, comparisons; management, etc.

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Branch Raise System at the Ruth Mine, Nevada Consolidated Copper Co. (83871 D). Walter S. Larsh. Ills. 1500 w. A I M E, Bul—Jan., 1918. Details of development.

Mining

Mining in the North-West (83726). Francis A. Thomson. 1500 w. Min & Sci Pr—Jan. 19, 1918. Labor supply; smelting and transportation facilities.

Mining in 1917

Mining in Utah in 1917. Edward R. Zalinski; in Colorado. George E. Collins; in Idaho. Robert N. Bell (83734). 8 pp. Eng & Min Jl—Jan. 19, 1918. Reviews.

Quarrying

War Time Quarrying in the High Peak (83745 A). Ills. 2500 w. Quarry—Jan., 1918. Quarries of the Buxton Lime Firms worked by women.

Russia

Mining Laws for Russia (83489). Horace V. Winchell. 1500 w. Min & Sci Pr—Jan. 5, 1918. General principles suggested to Ministry of Commerce & Industry.

Shafts

New Shaft at Kirkby Colliery (83639 A). Ills. 1800 w. Ir & Cl Tds Rev—Dec. 31, 1917. Detailed description.

Ventilation

Canvas Tubing for Mine Ventilation (83870 D). L. D. Frink. Ills. 2500 w. A I M E, Bul—Jan., 1918. Explains its use at Butte, Mont.

MINES AND DISTRICTS

Alaska

Mining Developments and Water-Power Investigations in South-eastern Alaska (83641 N). Theodore Chapin, H. M. Eakin, and G. H. Canfield. Maps. 90 pp. U S Geol Surv—Bul 662-B. Account of mining operations and water-power investigations.

Arizona

Gold, Silver, Copper, Lead and Zinc in Arizona in 1916 (83650 N). V. C. Heikes. 37 pp. U S Geol Surv, 1:10—Dec. 21, 1917. Mines report of production by counties.

British Columbia

Summary Review of Mining in British Columbia During 1917 (83891 N). E. Jacobs. 1500 w. Can Min Inst, Bul—Jan., 1918.

Colorado

Colorado Metal Production in 1917 (83624). Maps. 1500 w. Min & Sci Pr—Jan. 12, 1918. Output of gold, silver, copper, lead and zinc.

Dargalong

Dargalong Silver-Lead Mines, near Chillagoe, North Queensland (83636 N). Lionel C. Ball. Ills. 8000 w. Qnsd Gov Min Jl—Dec., 1917. History, production, geology, holdings, etc.

Idaho

Mining Distriets of Northern Idaho (83879). E. K. Soper. Map. 6000 w. Min & Sci Pr—Jan. 26, 1918. Geology the Cœur d'Alene region.

MINOR MINERALS

Bauxite

Bauxite in the Coastal Plain of Georgia (83486). Excerpts from report of H. K. Shearer. 4000 w. Eng & Min Jl—Jan. 5, 1918. Describes the geology, character, size and distribution, the methods of mining and treatment.

Carbonate Ores

Zinc Carbonate and Related Copper Carbonate Ores at Ophir, Utah (83649 N). G. F. Loughlin. Ills. 14 pp. U S Geol Surv, Bul 690A—Dec. 24, 1917. Occurrence, mineralogy, deposition, etc.

Gypsum

The Gypsum and Natural Whiting Deposits of Yorke Peninsula, South Australia (83634 N). L. J. Winton. 1200 w. Chem Eng & Min Rev—Nov. 5, 1917. Report for half-year ending June 30, 1917.

Gypsum Products, Their Preparation and Uses (83793 A). R. W. Stone. Ills. & Map. 53 pp. U S Bur Mines—Tech paper 158. Methods of mining or quarrying; equipment and operation of plants for reducing the crude rock to market products.

Manganese

Manganese in West Africa (83835 A). Stanley H. Ford. Ills. 1000 w. Min Mag—Dec., 1917. Recently discovered deposits now supplying English steel makers.

Undeveloped Manganese Ore Tracts in Shenandoah Valley, Virginia (83343). 1000 w. Mfrs Rec—Jan. 3, 1918. Information concerning deposits of promise.

Marble

On the Occurence of White Marble at South Ulam, Rockhampton District (83635 N). E. C. Saint-Smith. Ills. 4500 w. Qnsd Gov Min Jl—Dec., 1917. Unlimited supplies of commercial quality in Queensland.

Potash

A Neglected Chemical Reaction and an Available Source of Potash (83838 N). E. A. Asheroft. Maps. 7500 w. Instn Min & Met, Bul. 159—Dec. 13, 1917. Describes research work with feldspathic minerals and salts.

Bibliography on the Extraction of Potash from Complex Mineral Silicates, Such as Feldspar, Leucite and Glauconite (83839 A). Marl) (83597 A). E. C. Buck. 5 pp. Met & Chem Eng—Jan. 1, 1918. Serial 1st part. Useful in research work.

Enormous Deposits of Potash on Which America May Draw (83668). 2200 w. Mfrs Rec—Jan. 17, 1918. Possibilities of Searles Lake, in California.

Italian Leucitic Lavas as a Source of Potash (83598 A). Henry S. Washington. 7000 w. Met & Chem Eng—Jan. 15, 1918. Possible source of enormous supplies of potash including estimates of quantity.

Gisements De Potasse Nouveaux (83901 B). P. Sallior. Ills. 1800 w. La Nature—Nov. 24, 1917. New potash deposits in Alsace of immense value to Germany.

Recovery of Potash from Greensand (83666 B). H. W. Charlton. Read before Am. Soc. 2500 w. Jl Ind & Eng Chem—Jan., 1918. Details of a process of obtaining caustic potash and converting the residue into a material of value.

Rare-Earth Minerals

Zirconium and Rare-Earth Minerals in 1916 (83651 N). Waldemar T. Schaller. 10 pp. U S Geol Surv, 11:25—Dec. 22, 1917. Occurrenee, uses, production, etc.

Salt

La Consommation Et La Production Du Sel (83937 B). N. Flamel. 3000 w. Le Génie Civil—Nov. 17, 1917. Serial. 1st part. Various methods of salt production and manufacture.

Tin

Tin Deposits of Irish Creek, Virginia (83484). Henry G. Ferguson. Sketch maps. 2200 w. Eng & Min Jl—Jan. 5, 1918. Report of tin veins in Rockbridge County and the prospect of sucessful development.

OIL AND GAS

Cracking Processes

The Rittman and other Cracking Proccesses (83659 A). H. G. James. 1200 w. West Eng—Jan., 1918. Recent improvements makes possible large increase in production of gasoline.

Gas

Future Gas-Making Practice (83921). 2200 w. Times Engng Supp—Nov. 30, 1917. Effect on the methods employed of the change in standard of calorific power for coal gas in England.

Gasoline

Extraction of Gasoline from Natural Gas as an Industry Allied to Production and Refining of Petroleum (83872 D). Frank P. Peterson. Ills. 4500 w. A I M E—Dec., 1917. Details of important factors.

Illinois

Oil and Gas Fields of Illinois (83860). H. A. Wheeler. Ills. & Map. 2500 w. Eng & Min Jl—Jan. 26, 1918. Occurrences which have made Illinois the second largest producer of high grade oil since 1907.

Oil

Water Surfaces in the Oil Fields (83866 D). Marcel R. Daly. Ills. 2500 w. A I M E, Bul—Jan., 1918. A study of the conditions of equilibrium of the "free surface" of a water body enclosed in a porous medium.

Oil Recovery

Methods for Increasing the Recovery from Oil Sands (83792). J. O. Lewis. Ills. 14 pp. U S Bur Mines—Bul. 148. Principles involved in increasing recovery and methods of extracting more oil.

Oil Supply

An Optimistic View of the Future Supply of Oil (83604 A). I. N. Knapp. Ills. 11 pp. E Cb Phila, Jl—Jan., 1918. Shows that supplies of shale oil to supplement petroleum makes an oil famine improbable.

ORE DRESSING

Concentrator

The Taylor Concentrator for Tin and Lime (83836 A). J. Waring Partington. Ills. 1200 w. Min Mag—Dec., 1917. Particulars of a new table which is giving improved results.

Crushing

Recent Tests of Ball-mill Crushing (83869 D). C. T. Van Winkle. 3000 w. A I M E, Bul—Jan., 1918. Tests of Hardings vs. Marcy mill at Inspiration, etc.

Ore Dressing

East Pool Dressing Practice (83837 A). Flow-sheet. 1500 w. Min Mag—Dec., 1917. Present practice in dressing of Cornish tin—wolfram—arsenic ores.

PRECIOUS METALLURGY

Cyaniding

Precipitation Electrolytique Des Solutions De Cyanure (83036 B). 3000 w. L'Industrie Electrique—Dec. 10, 1917. Methods of electrolytic precipitation of gold, silver and copper from cyanide solutions.

Precipitation

Charcoal Precipitation of Gold-Bearing Cyanide Solutions (83633 N). H. G. Walton. Ills. 1000 w. Chem Eng & Min Rev—Nov. 5, 1917. Report of department of mines, Western Australia, for year 1916.

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RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Canada

Railway Progress in Canada During the Year 1917 (83463 A). J. L. Payne. Ills. 2500 w. Ry Age—Jan. 4, 1918. (Special No.) Roads worked under heavy pressure with shortage of labor.

Collision

Side Collision Between Passenger Trains (83626). Ills. 3500 w. Ry Sig Engr—Jan., 1918. Abstract of report on the wreck at Larmond, Va.

Efficiency

American Railway Efficiency During the War (83462 A). 4500 w. Ry Age—Jan. 4, 1918. (Special No.) Reviews accomplishments and increased service in nine months since U. S. entered conflict.

Government Control

Nation's Railroads Now Under Government Control (83491 A). Also editorial. Photographs. 10000 w. Ry Age—Jan. 4, 1918. (Special No.) Details of new organization. Probable changes.

Government Operation

Director General of Railroads McAdoo on the Job (83541). 4500 w. Ry Age—Jan. 19, 1918. "Freight-moving-week" ordered; demurrage rates increased; passenger service curtailed.

Running the Railroads Under the New Regime (83680). 4500 w. Ry Age—Jan. 18, 1918. Freight moving week; status of the I. C. C. and the State commissions; wages and mail service.

Railroad Problems

Railroad Problems and Conditions Growing Out of the War (83338 A). R. H. Ashton. 3500 w. West Ry Cb, Pro—Nov. 10, 1917. Reviews the work accomplished by railroads in the United States under the War Board.

Signaling

Progress in Railroad Signaling During the Year (83469 A). Ills. 6 pp. Ry Age—Jan. 4, 1918. (Special No.) Marked progress in interlocking.

Review of Signaling in the Past Year (83625). 9 pp. Ry Sig Engr—Jan., 1918. Record of block signals and interlockings completed, under construction, and contemplated.

Signals

Report of Committee X—On Signals and Interlocking (83805 C). Ills. 27 pp. Am Ry Eng Assn, Bul—Nov., 1917.

Terminal Facilities

Increase Engine Terminal Output (83732 A). Articles by F. P. Roesch, E. J. Harrison, F. W. Taylor, John C. Murdock. 2500 w. Ry Mech Engr—Jan., 1918. Suggestions for improving facilities.

Train Control

Maximum Speed Retardation and Rail Conditions as Related to Control of Trains (83549 A). Walter V. Turner. 5000 w. Ry & Loc Eng—Jan., 1918. How to realize the best economy in the control of trains.

Train Handling

Train Handling (83473). G. H. Wood. 2200 w. Ry Rev—Jan. 5, 1918. From *Santa Fe Emp. Mag.* Advocates increased piston travel and careful draw gear inspection.

See also Compensation, Railway Finance, Railroad Securities and Valuation, under INDUSTRIAL MANAGEMENT, *Finance and Costs;* and Administration Bill, under *Regulation.*

MOTIVE POWER AND EQUIPMENT

Cars

All Wood and Composite Hopper Cars for the Norfolk & Western Railway (83472 A). B. W. Kadel. Ills. 2500 w. Ry Rev—Jan. 5, 1918. Details of two recent designs.

Freight Car Orders in 1917 Reach Low Level (83468 A). Ills. 8 pp. Ry Age—Jan. 4, 1918. (Special No.) Domestic orders lowest since the year 1908.

The Business Box Car (83796 A). W. J. Bohan, with discussion. 10000 w. West Ry Cb, Pro—Dec. 17, 1917. Business of a box car and the relation of its construction.

Design

The Universities and Equipment Development (83731 A). Ills. 3000 w. Ry Mech Engr—Jan., 1918. Value to the designer of scientific investigation.

Draw Gear

Friction Draw Gear (83546 A). Ills. 2500 w. Ry & Loc Eng—Jan., 1918. Capacity of draw gear; difference in give between wooden and steel cars. Tests.

Electric Locomotives

Developments in Electric Locomotives in Italy (83380 A). Ills. 1200 w. Engng—Dec. 14, 1917. Serial. 1st part. Deals with improvements on the electric locomotives of the Italian State Railways.

Mechanical Problems in the Design of Electric Locomotives (83581 A). W. K. McAfee. Ills. 2000 w. Elec Jl—Jan., 1918. Problems relating to tracking qualities, transmission of power from the motors to the rails, and design of motors.

Electrification

Electrification of Railroads as a War Measure (83579 A). F. E. Wynne. Ills. 1800 w. Elec Jl—Jan., 1918. What electrification is capable of doing.

Further Railroad Electrification Important (83520). F .H. Shepard. Ills. 2000 w. Elec Ry Jl—Jan. 5, 1918. Aims to show that electrical equipment gives an effective way of increasing transportation capacity.

Guides

Adjusting the Guides and Crossheads (83548 A). Ills. 1800 w. Ry & Loc Eng—Jan., 1918. Directions for proper adjustment.

Headlights

Locomotive Headlights (83547 A). 2000 w. Ry & Loc Eng—Jan., 1918. Peculiarities of the parobolic curve; the electric headlight; how case and reflector serve their purpose.

Locomotive Performance

Increase Locomotive Operating Efficiency (83727 A). Clement F. Street. Ills. 3000 w. Improvements being made with a view to increasing earnings.

Performance of the Mohawk or 4-8-2 Locomotive of the New York Central Railroad (83550 A). Ills. 500 w. Ry & Loc Eng—Jan., 1918. Good tractive effort at high speed.

Locomotives

Conversion of Single-Expansion to Compound Engines on French Railways (83385 A). Ills. & Plate. 1000 w. Engr—Dec. 14, 1917. Arrangements adopted.

1917 a Record Breaker in Locomotive Orders (83467 A). 6 pp. Ry Age—Jan. 4, 1918. (Special No.) Orders totaling 7,642 as compared with 5,863 in 1916. Bright prospects for coming year.

Trains

Special Train for the Director-General of Transportation (83767 A). Ills. & Plate. 1000 w. Engr—Jan. 4, 1918. Built by the North-Eastern Ry. Co. of England for the British Director-General and his staff.

PERMANENT WAY AND BUILDINGS

Freight Terminal

New Ocean Freight-Terminal Started on Staten Island (83675). Ills. 1800 w. Eng News-Rec—Jan. 17, 1918.

Snowsheds

Telescope Sections for Latest Timber Snowsheds (83457). Ills. 1000 w. Eng News-Rec—Jan. 3, 1918. Features developed by Southern Pacific Co. in Sierra Nevadas.

Track Elevation

Track Elevation Work of the P. C. C. & St. L. Ry. in Cincinnati (83766). Ills. 1000 w. Ry Rev—Jan. 19, 1918. Details of construction.

Track Stresses

See same heading under CIVIL ENGINEERING, *Measurement.*

ROADS AND PROJECTS

Alaska

The Government Railroad of Alaska (83318). Theodore Pilger. Ills. & Map. 5000 w. Min & Sci Pr—Dec. 29, 1917. First American railroad built and owned by United States government. Details of development.

Australia

The Australian Trans-Continental Railway from Port Augusta to Kalgoorlie (83755 A). E. A. Box. Ills. 3000 w. Engng—Dec. 28, 1917. History of a great undertaking accomplished under many difficulties.

Baghdad Ry.

The Baghdad Railway and Its Part in the War (83816). Map. 2500 w. Ry Age—Jan. 25, 1918. Mesopotamia campaign has hindered the completion.

Construction

Railway Construction and Operation in the Fighting Zone of France (83679). Extract from lecture by Leslie F. Van Hagan. 1800 w. Eng & Con—Jan. 16, 1918. Describes work of American and Canadian railway regiments in handling troops and supplies at the front.

France

Les Voies De Communication Directes Entre France Et Italie (83002 B). Ills. 1200 w. La Nature—Nov. 24, 1917. Railways and highways between France and Italy. Characteristics and advantages of each.

New Construction

New Railway Construction in Foreign Countries (83464 A). P. Harvey Middleton. 5000 w. Ry Age—Jan. 4, 1918. (Special No.) Projects in South America, Asia, and Africa.

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Construction Activities During the Year (83466 A). Ills. & Curves. 8 pp. Ry Age—Jan. 4, 1918. (Special No.) Total mileage of new lines completed in 1917 compares favorably with the two preceding years.

P. R. R.

The New Pennsylvania Entrance Into Indianapolis (83814). Ills. 2500 w. Ry Age—Jan. 25, 1918. Line between Ben Davis and Frankfort, in Indiana, gives complete line between Indianapolis and Chicago.

TRAFFIC

Car Loading

Pennsylvania Lines Specialize in Car Conservation (83818). 2500 w. Ry Age—Jan. 25, 1918. Excellent results from intensive loading.

Coal Movement

Director General McAdoo Speeds Up Coal Movement (83542). Ills. 1500 w. Ry Age—Jan. 10, 1918. Complications of the fuel problem.

Freight Handling

Freight Handling at the Panama Canal (83558 A). Ills. 1500 w. Int Mar Eng—Jan., 1918. Introduction of storage—battery trucks.

Loading

Methods of Locating Lumber in Open Top Cars (83682). Ills. 1000 w. Ry Age—Jan. 18, 1918. Serious waste of equipment and labor due to failure to prevent shifting of lading.

Ore Transportation

All Forces United in Moving Lake Ore (83434 D). F. L. Prentiss. Ills. 1800 w. Iron Age—Jan. 3, 1918. (Special No.) Change in methods due to war necessities.

MISCELLANY

British Railways

The Future of British Railways (83387 A). 2000 w. Engr—Dec. 14, 1917. Serial. 1st part. The difficulties and how they may be met when Government control terminates.

Canada

The Railway's Part in Developing Western Canada (83539). Ills. 4000 w. Ry Age—Jan. 11, 1918. Methods of the Canadian Pacific in attracting settlers.

Scrap

Scrap Reclamations on the Atchison, Topeka & Santa Fe Ry. (83856). Charles E. Parks. Ills. 2500 w. Ry Rev—Jan. 26, 1918. Serial. 1st part. Résumé of practice in collecting classifying and salvaging waste.

STREET AND ELECTRIC RAILWAYS

Axles

Car Axles—Their Design, Manufacture and Service (84053). Norman Litchfield. Diagrams. 1500 w. Elec Ry Jl—Feb. 2, 1918. Serial, 1st part. Estimating fiber stress is considered.

Cars

How the Pay-As-You-Pass Car Was Developed (83522). Peter Witt. Ills. 2500 w. Elec Ry Jl—Jan. 5, 1918. Explains how the present Cleveland car cuts down boarding and alighting time and insures collection of fares. Possibility of further development.

The Front-Entrance, Center-Exit Car and Higher Schedule Speed (83710). Ills. 2500 w. Elec Ry Jl—Jan. 19, 1918. Experience in several cities favorable.

Economy

Economy and the Railway Man (83708 A). R. E. Danforth. 5500 w. AERA—Dec., 1917. Ways in which operating expenses can be kept down without impairing quality of service.

Electric Railways

Applying Engineering and Selling Principles to Electric Railway Transportation (83521). J. F. Layng. 23 pp. Elec Ry Jl—Jan. 5, 1918. A discussion of the present situation and its connection with the conservation of the nation's resources.

England

Traffic Problems in British Cities (83919). 2000 w. Times Engng Supp—Nov. 30, 1917. Special problems in different cities; traffic density as compared with those in other cities of the world.

Maintenance

Railway Equipment Maintenance (83797 A). John S. Dean. 1000 w. AERA—Dec., 1917. Serial, 1st part. The present article deals with organizations.

Montreal

Electric Railway Power at Montreal (83563). Ills. 2000 w. Elec Ry Jl—Jan. 12, 1918. Principal dependence is on hydraulic plants. Explains general plan.

Rail Return

Sur Le Retour Du Courant Par Les Rails (83933 D). E. Brylinski and G. Girousse. 12000 w. Bull Soc Internationalle Des Electriciens—Nov., 1917. Mathematical treatment of return current in tramway rails. Voltage, location of feeders, etc.

Rail Wear

An Early Experimental Study of Rail Wear (83852). R. C. Cram. Ills. 2500 w. Elec Ry Jl—Jan. 26, 1918. First use of electric weld joints, with abstract of paper by A. J. Moxham, read in 1898.

Zone System

Zone System Approved for Holyoke Company (83565). 4000 w. Elec Ry Jl—Jan. 12, 1918. Decides that zone system with central 5-cent area is best suited to local situation.

BOOK NOTICES

A MUNICIPAL EXPERIMENT, by Reginald P. Bolton. Size, 5x8 inches; 238 pages. Ills. Price, $1.00 New York: Bureau of Public Service Economics, Inc.

This is a description of the power plant installed in the Hall of Records, New York City. The reasons for using an isolated plant and the results attained with it.

MOTION PICTURE EDUCATION, by Ernest A. Dench. Size, 5x8 inches; 354 pages. Price, $2.00. Cincinnati: The Standard Publishing Company.

A well written exposition of the numerous and varied ways in which education is assisted by the use of films.

EXAMPLES IN BATTERY ENGINEERING, by Prof. F. E. Austin. Size, 4½x7½ inches; 90 pages. Ills Price, $1.25. Hanover, N. H.: Published by the author.

This is a compact, useful text book similar to the others of the series in electrical engineering by this author, but more detailed in the problems whose application and solution are given.

RESULTS OF MANAGEMENT with Practical Instructions on Machine Building, by William Lodge. Size, 5x8 inches; 140 pages. Price, $1.50. New York: McGraw Hill Book Company, Inc.

PRECISION GRINDING MACHINES, by Thomas R. Shaw. Size, 5½x8½ inches; 214 pages. Ills. Price, $4.50. London: Scott, Greenwood & Company, New York; The Van Nostrand Company.

A book giving detailed descriptions of the latest types of grinding machines and methods of using them.

INTERNAL COMBUSTION ENGINE MANUAL, by F. W. Sterling. Size, 6x9 inches; 168 pages. Ills. Price, $2.00. Washington, D. C.: Pub. R. B. Beresford: fourth edition, 1917.

This book, written by Lieutenant Commander Sterling, of the United States Navy, gives complete descriptions of every type of gasoline and heavy oil engine used in the navy. It is in use at the Naval Reserve Officer School at Annapolis, as well as at the Sheffield Scientific School of Yale.

TELEGRAPH PRACTICE, a Study of Comparative Method, by John Lee. Size, 5x7½ inches; 102 pages. Price, $1.00. London and New York: Longman's Green & Company.

A general review of English and continental methods of telegraph practice, outlining some of the recent systems in use, but giving no details of apparatus or line connection.

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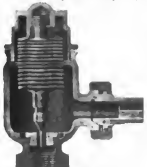

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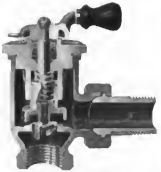

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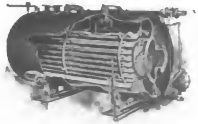

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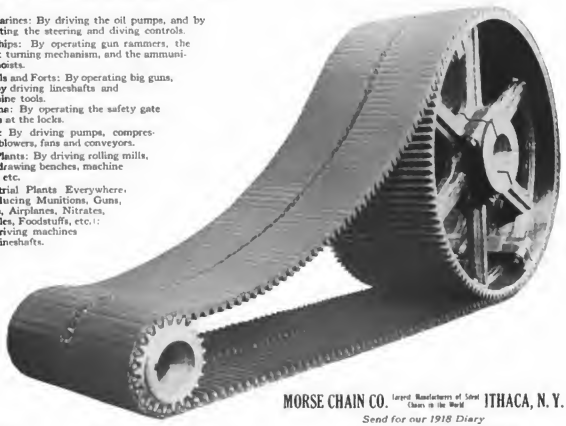

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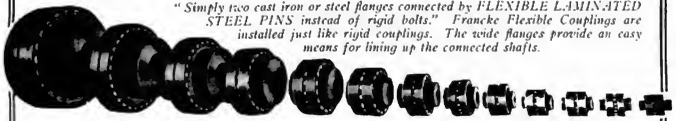
ANY POWER – ANY SPEED – ANY SERVICE

"Simply two cast iron or steel flanges connected by FLEXIBLE LAMINATED STEEL PINS instead of rigid bolts." Francke Flexible Couplings are installed just like rigid couplings. The wide flanges provide an easy means for lining up the connected shafts.



FRANCKE FLEXIBLE COUPLINGS

FOR DIRECT CONNECTED MACHINERY SHAFTS

New lists show 37 standard sizes suitable for shafts from ½" dia. up to 12" (larger sizes on application), detailed description and FRANCKE Specifications, giving 23 items necessary to insure successful flexible couplings for any service. These specifications are based on our experience in supplying and closely following successful installations on direct coupled machinery aggregating over a million and a quarter h.p.

They provide for free endwise movement, for angular and parallel misalignments.

They eliminate misalignment-friction, vibration, noise, bearing wear and shaft breakage. They save operating trouble and expense.

FRANCKE flexible couplings have been successfully applied to practically every kind of power-driven machinery, two bearings on each connected shaft—four in a row. You can and should carefully line them up—but they will not stay in line. The FRANCKE makes successful operation possible.

NEW LISTS READY

and effective December 15, 1917, showing added sizes, new prices, complete description and engineering data.

For quotation and in ordering please specify number required; kinds of machines connected, H.P., R.P.M., and both shaft sizes.

SMITH-SERRELL CO., Inc.

General Sales Agent for The Francke Co.

142-A Cedar St., New York City

SMITH CLEAN-GAS PRODUCERS

Plant installed for The Timken Detroit Axle Co. Furnishes gas for Heat Treating and Forging.

For refined heating operations on special steels where accurate temperature control is necessary Clean Cold Producer Gas is an ideal fuel.

The gas is distributed under pressure. It is accurately controlled by positive valves. It produces a uniform mellow heat which does not burn the metal.

Hearth atmospheres can be controlled so as to prevent oxidation.

Smith Clean Gas has been adopted by many concerns requiring special service.

A large list of plants and a description of the service being rendered will be gladly furnished.

THE SMITH GAS ENGINEERING CO., Lexington, Ohio

Sole Canadian Representatives, THE CANADIAN ALLIS-CHALMERS, Ltd., Toronto

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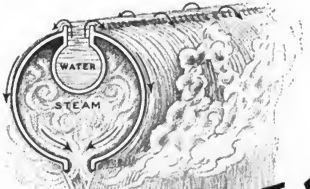

NATIONAL

DIRECT CONTACT FEED WATER HEATER

For Every Kind of Feed Water— For Every Power Plant

The water is first heated by surface contact and then brought to maximum temperature by actual contact or mingling with the steam. This is the feature which distinguishes the National from all other open heaters.

The contact pipes are double. From the inner, the water overflows the port at the top and passes around the large pipe as a thin film. It is broken into fine spray at the bottom. The steam leaving the outer pipe at the bottom passes through the spray, and finally all water and steam are in direct contact above the filter bed.

Ask for Catalog No. 52

The National Pipe Bending Company

72 River Street, New Haven, Conn.

Manufacturers of Closed Coil Type Feed Water Heaters, Direct Contact Open Type Heaters and Purifiers, Storage Heaters, Steam and Oil Separators, Coils and Bends of Iron, Brass and Copper Pipe. 46-81

When making inquiry please mention INDUSTRIAL MANAGEMENT for March

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Speaking of "Repeat Orders"

Ten years ago after some strenuous salesmanship, we succeeded in placing three or four Deming Power Pumps with a big manufacturing institution, the world's largest of its kind. At the present time more than one hundred

DEMING

Power Pumps

Are in use by this concern. The illustration shows a corner in one of the pump rooms.

Name of the above concern and many others who use batteries of "Demings," sent upon request.

THE DEMING COMPANY
Salem, Ohio
Hand and Power Pumps For All Uses

General Distributing Houses:

Chicago—Henion & Hubbell, 217-221 N. Jefferson St.
Pittsburgh—Harris Pump & Supply Co., 339-341 Second Ave.
Richmond, Va.—Sydnor Pump & Well Co.
New York—Ralph R. Carter Co., 159 Chambers St.
Philadelphia—W. P. Dallett Co., 49 N. 7th St.
Boston—Chas. J. Jager Co., 18 Custom House St.

If You Are Thinking of Buying a Separator

take a few minutes to look into the *plan* and *sizes* of the machines offered. There is a reason why thousands of Sweets have been sold on duplicate orders.

Also makers of good exhaust heads and flanged fittings.

DIRECT SEPARATOR CO.
218 South Geddes Street
SYRACUSE, N. Y.

GIANT SEMI-DIESEL FUEL OIL ENGINE

owned by the Laurel Milling Co., Laurel, Nebr.

Absence of intricate mechanism and delicate adjustments and general simplicity of construction make the Giant Engine the ideal prime mover for isolated power plants. No expert attendance is required and the cost of operation is extremely low.

Made single and duplex in capacities from 20 to 160 H.P.
Write for Bulletin 34-W

CHICAGO PNEUMATIC TOOL CO.
1040 Fisher Building CHICAGO — 52 Vanderbilt Avenue NEW YORK
Branches Everywhere

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The Super-Service Belt

HOYT'S FLINTSTONE
EDW. R. LADEW CO. INC.
GLEN COVE, N.Y. U.S.A.

"In figuring the total expense of belting, and the manufacturing cost chargeable to this account, by far the largest item is the time lost on the machines while belts are being relaced or repaired."

Kent's M. E. Pocketbook.

Ever think of that? Read it again and let it sink in. It makes the first cost of a belt rather a secondary factor in the belting problem, doesn't it?

Fact is, the price of a belt doesn't stand for anything, unless it is a true index to what that price buys.

Low first cost, low service value—high first cost, high service value. That must be so evident that argument is unnecessary, to demonstrate it.

LADEW LEATHER BELTING costs more because it is worth more. The extra price isn't absorbed in extravagant shop costs nor does it go into "excess profits." It pays for those qualities in leather and workmanship which assure the buyer a longer-lived belt, a more dependable belt, a belt of tremendous driving power, a belt that keeps the "largest item" referred to above, down to the practical limit.

Ask Ladew Engineering Service how to reduce your belting costs. Our engineers can show you.

BELTING
EDW. R. LADEW CO. INC.
GLEN COVE, NEW YORK, U.S.A.

THE PERFECT BELT
HOYT'S TURTLE BACK
LEATHER
WATERPROOF BELTING

The Original Waterproof Leather Belt

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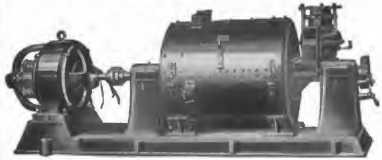
Complete Combustion Gets the Last B. T. U. From Coal

The Aero-Pulverizer reduces coal to an impalpable powder and surrounds each particle with the right amount of air for complete combustion. The powdered coal and air enter the furnace the instant they leave the pulverizer. No superfluous air cooling the fire box—no opening of furnace doors are among the advantages offered by

The AERO PULVERIZER

It makes coal burn like gas, in a flame that may be lengthened or shortened —made oxidizing reducing or neutral—preventing waste in application.
It gets the last B. T. U. from low priced slack coal.
One man can attend to a number of pulverizers.



THE RESULT

Conservation of the two vital factors to intensive production—*coal and labor.*

The Aero Pulverizer is backed by the longest successful service of any pulverized coal equipment on the market.

If you can buy all the coal and hire all the labor you want to cheaply—the Aero-Pulverizer will not interest you. If not, you had better write us for literature *at once.*

THE AERO PULVERIZER CO.

Suite 1441
120 BROADWAY
NEW YORK

THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

Water Tube Steam Boilers

STEAM SUPERHEATERS **MECHANICAL STOKERS**

Works: BARBERTON, OHIO BAYONNE, N. J.

BRANCH OFFICES:

BOSTON, 49 Federal Street
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POWER DRIVEN AIR COMPRESSORS

With Automatic Selective Proportional Unloaders

Distinctive
Engineering Advance

Radical
Mechanical Improvements

THE NORWALK IRON WORKS CO.

SOUTH NORWALK
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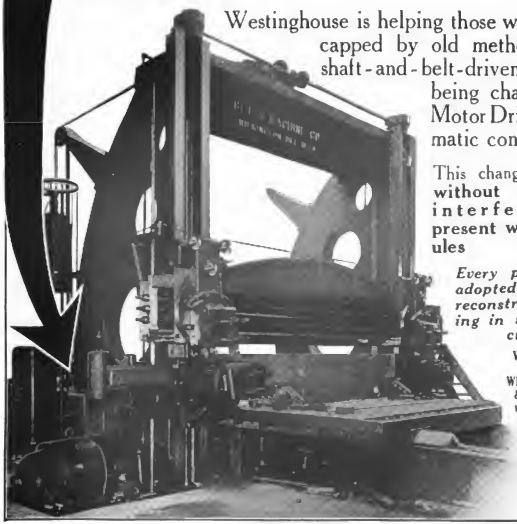
Westinghouse
Motors & Control

As Sure As The Sun Rises And Sets—

—we MUST improve and rebuild as WE GO—else pay the penalty in the end.

In normal times you "got along" with your old equipment. Today you find this equipment inefficient—and production slow.



Westinghouse is helping those who are handicapped by old methods. Line-shaft-and-belt-driven plants are being changed over to Motor Drive, with automatic control.

This change can be made **without objectionable interference with present working schedules**

Every plant that has adopted this process of reconstruction is gaining in speed and efficiency.

Write for Book No. 3042

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
EAST PITTSBURGH, PA.

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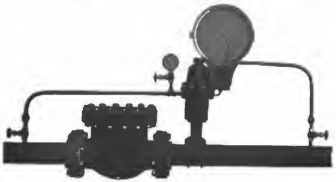
THE WESTCOTT ORIFICE METER

AND

BALLARD-WESTCOTT DIFFERENTIAL and STATIC PRESSURE GAUGE



Mercury Type Gauge

One Recording Chart

Prover Tested Orifices

For measuring air, natural gas, artificial and coke oven gas in large or small volumes at high and low pressure

Write for bulletin No. 107

Metric Metal Works ESTABLISHED 1888 **Erie, Pa.**

MANUFACTURERS OF **GAS METERS** FOR ALL PURPOSES

Check the N. T. Bulletins you want

- ☐ Steam Pumps, Duplex.
- ☐ Steam Pumps, Single.
- ☐ Power Pumps, Horizontal.
- ☐ Power Pumps, Vertical.
- ☐ Gas Engines, Horizontal.
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- ☐ Automatic Feed Pumps & Receivers.
- ☐ The Foam System for Extinguishing Oil Fires.
- ☐ Tools for Pipe Line Construction.

—and mail this advertisement to Dep't "A"

NATIONAL TRANSIT PUMP & MACHINE CO.

Main Offices and Factories:

OIL CITY, PA.

District Offices in New York, Philadelphia, Pittsburgh, Kansas City

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Three Cameron Class "DV" Centrifugals installed in Mississippi Municipal Plant

REDUCED PUMP COSTS

The above illustration shows three Cameron Class "DV" Centrifugal Pumps, direct connected to electric motors. These

CAMERON CENTRIFUGALS

have a combined capacity of 3750 G.P.M., and have been installed in a Mississippi Municipal Plant for the past three years.

They give a greater capacity, occupy much less space, and cost less for upkeep and attendance than the triple expansion and direct acting steam driven pumps which they replaced.

This is just another instance where Cameron Centrifugals have made a big reduction in municipal pump costs, and further proof that they embody most correct principles of design.

Bulletin No. 7150 gives full details It's free.

A. S. Cameron Steam Pump Works

11 Broadway, New York Offices the World Over

15 V

DAVIS

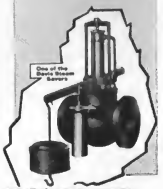
PRESSURE REGULATORS

CAN SAVE STEAM IN EVERY PLANT—IN YOUR PLANT

In big power plants and in little plants, correct steam pressure for the various uses is essential to economical operation. The Davis Pressure Regulator saves steam by reducing the generated high pressure to the lower pressures as needed.

The desired pressure is obtained by adjusting the number of weights on the lever arm. The pressure is *weighed*, because the Davis Pressure Regulator is built like a pair of balance scales—just as simple and just as accurate. As simple and unfailing as the law of gravity, because it is controlled by gravity. There are no springs; no diaphgram to give trouble.

The new valve booklet contains some mighty useful information about valves and piping and will be sent free on request to the G. M. Davis Regulator Co., 430 Milwaukee Avenue, Chicago



DAVIS VALVE

STEAM SAVERS SINCE 1875

SPECIALTIES

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"Without fear and without reproach" you may order

WYOMING STEAM TRAPS

You need have no fear about their performance, and you will never have occasion to reproach yourself if you order them.

Their ingenious simplicity and their rapid discharge are assurance of dependability, but so you may check our assertions in your own way, we will lend you a Wyoming Steam Trap for a thirty day test. The obligation and the expense will be ours.

W. H NICHOLSON & CO.

119 Oregon Street

WILKES-BARRE, PA.

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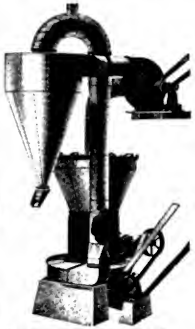
PRODUCING ECONOMIES IN YOUR GRINDING DEPARTMENT AND REDUCING YOUR ULTIMATE COST OF MANUFACTURING IS OF AS MUCH INTEREST TO US AS IT IS TO YOU.

It is for this reason that we maintain our engineering service in conjunction with the



RAYMOND HIGH SIDE ROLLER MILL

RAYMOND Pulverizing & Air-Separating SYSTEM

This engineering service is at your disposal at all times to give the best advice from a long experience in the Pulverizing Field.

The Raymond System itself is the combination of this engineering service and an economical grinding machine which produces a uniform finished product in one operation.

In developing our grinding mills to their present standard we have not looked at the economy side only, but have kept foremost in our minds that continuous service for many years with an upkeep and operating cost that remains constant would mean the production of an efficient as well as economical grinding machine.

It is this efficient and economical grinding machine with the service of experts who understand Air-Separation thoroughly that we offer to you in the Raymond System.

You may think you understand Air-Separation thoroughly and know what it will do for you, but if you tell us what your problem is we may be able to throw a new light on the subject.

At least an investigation will cost you nothing.

RAYMOND BROS. IMPACT PULVERIZER CO.
1307 NORTH BRANCH STREET CHICAGO, ILL.

Western Representatives: The Dry Milling Engineering Co., 207 Boston Building, Denver

ADVANTAGES OF DIAMOND CHAIN DRIVES

Long Life
Low First Cost
High Efficiency
Positive Speed Ratio
Small Space Required
Wide Range of Application
No Loss of Speed by Slipping
Not Effected by Moisture, Heat or Dust
Especially Efficient on Short Center Drives

Advise us your requirements, and secure our recommendation for consideration. We have at hand information and data accumulated through many years' experience in chain drives for varied purposes—perhaps some in your particular line of work. Write for treatise descriptive of the new "Diamond" tooth form, which is being adopted by machinery builders in all lines.

DIAMOND CHAIN & MFG. COMPANY
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Open Hearth Sheets For Every Purpose

Sixty years of specialized manufacturing stands back of the constant uniformity, ductility and pliability of every La Belle Sheet.

Every process of manufacture, from our own mine, through the modern equipped La Belle mills, undergoes inspection so rigid that "flawless, uniform La Belle quality" has become a byword with the trade.

La Belle sheets will work up more easily, with less possibility of cracking or bending and with less waste than any sheets your money can buy.

Let us figure on your Sheet requirements.

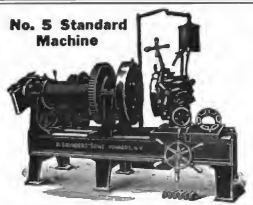
La Belle Iron Works

"From Mine to Market"

General Offices:—Steubenville, Ohio
Plants:—Steubenville, Ohio, and Wheeling, W. Va.

LABELLE

No. 5 Standard Machine



More Than Meets the Standard of Perfection Trade Requirements Demand.

SAUNDERS Pipe Threading and Cutting Machine

Eliminates All Chance of Crooked Threads.
The pipe revolves, the dies remain stationary.
Threads Short Lengths Without Use of Nipple Chuck.
Design allows bringing of adjustable die head close up to the gripping chuck.
Uniform Surface Speed for Each of the Different Sizes of Pipe.
Belting and gearing proportioned to effect this, thus assuring uniform results.
Designed and Constructed to Afford Speed—Accuracy—Simplicity.
Interested in threading Iron and Steel Pipe? Then our Catalogue R is what you require.

D. SAUNDERS' SONS, Inc.
YONKERS, N. Y.

"DIAMOND" Fibre Gears

wear longer and better. Because they are made of a specially prepared gear fibre, which is a dense homogeneous material of high specific gravity. Diamond Gear Fibre should not be confused with ordinary Vulcanized Fibre.

Write for Gear Bulletin No. 13. Illustrating some gears and pinions. Better still, send us your sketch or blue-print and we will submit prices.

Diamond State Fibre Co.
Bridgeport, Pennsylvania
PHILADELPHIA CHICAGO
NEW YORK BOSTON

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TURBO GEAR
FAST PATENTS

50 H.P. Turbo-Gear Direct-Connected to Motor-Driven Centrifugal Pump Speed Reduction 1140 to 219 R.P.M.

Ideal Drive for Pumping Installations

Generally speaking, the pump is an after thought. That's why it's usually poked in some out-of-the-way corner that happens to be available after all the other machinery is set up.

If you *have* to poke the pump in an out-of-the-way place set it up with *a drive that you can poke in alongside of it and forget.* A drive that will run year-in and year-out without any attention, but the occasional filling of the oil reservoir—A TURBO GEAR.

Standard Turbo-Gear Speed Transformer

The Turbo-Gear will allow you to obtain the speed reduction most economical or effective for pump operation with least loss of energy in transmission. It will save much valuable floor space and remain unaffected by the adverse water, moisture or atmospheric conditions so conspicuously prevalent in most pump installations.

Reasons why are fully set forth in Bulletin 100. Yours for the asking.

The Poole Engineering & Machine Company

Manufacturers of Gears and Power Transmission Machinery since 1843

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Minneapolis, 716 McKnight Bldg.
New York, 50 Church St.

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Pittsburgh, 781 Union Arcade Bldg.
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HEAT CONTROL—

Fuel Economy
Material Economy
Product Quality

War has made all three essential. Heat control can only be secured by the use of accurate thermometers and pyrometers.

PRECISION THERMOMETERS

AND HYDROMETERS ARE GUARANTEED TO BE ACCURATE

We are safe in doing this. Our instruments are constructed of the best materials for their respective purposes. They are thoroughly tested and inspected before they leave our hands. Quality is the only consideration in their manufacture.

We offer to the technical world a complete line of engineering thermometers and their complementary instruments.

OUR SPECIALTY

Building instruments to order for particular requirements which stock instruments fail to meet.

Write for catalogue.

PRECISION THERMOMETER & INSTRUMENT CO.

1434 Brandywine Street Philadelphia, Pa.

gives longer and better service, at lower cost, run cooler, reduces the frictional load over other bearing metals, and can be used for ***all bearings.*** Use "NOHEET" and cut cost.

Save time, worry and labor.

THE LUBRICATING METAL CO.
2 Rector St., New York

CLEVELAND CHICAGO PITTSBURGH
PORTLAND CINCINNATI

CUT GEARS

OF EVERY DESCRIPTION

IXL Rawhide Pinions

Specialists in Heavy Hardened Truck and Traction Gears. Right Price, Delivery and Quality.

FOOTE BROS. GEAR & MACHINE CO.
Chicago, Ill.

Send for Catalogue "ME"

AWARDED GRAND PRIZE Supreme Award of Merit

American Wire Rope

For All Purposes

Made by

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Chicago New York Cleveland
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is now done by the SCLEROSCOPE almost exclusively. The advantages gained are so positive that few firms are without it to-day. Send for our 80 page booklet free.

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by the PYROSCOPE will help to solve your economic problems. Learn of its advantages in hardening, founding, forging, etc. Pamphlet free.

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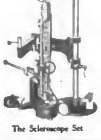
By the SHORE Process



The Scleroscope Set

SHORE INSTRUMENT & MFG. CO., INC.
555-557 W. 22nd St. New York

Agents in all foreign countries

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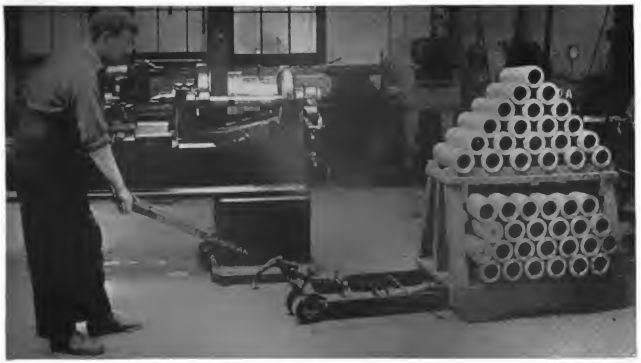

A National-Chapman Elevating Truck Handling Shrapnel Shells in a Munition Factory.

NATIONAL ELEVATING ROLLER BEARING TRUCKS CHAPMAN

They Save Man Power and Overcome Labor Shortage

MANY of the greatest industrial plants of the country now use National-Chapman Elevating Trucks.

Under present conditions of labor shortage, the saving of man power effected by this system of shop trucking is a prime consideration—but not the only one.

For the National-Chapman Truck helps production. Its detached skids can be made in the form of boxes, bin sections, crates, racks, tables, etc., either machine high or otherwise, to lessen the number of time consuming motions at machines. It provides a means by which the positions of all pieces of material transported can be standardized, and so handled by each machine worker as to be replaced on the container in the most convenient position for the next operation.

All trucks are equipped with Hyatt Roller Bearings, which insure easy haulage.

NATIONAL SCALE COMPANY

3 Ring Street **Chicopee Falls, Mass.**

Estimates Furnished on Steel Stampings

FOREIGN REPRESENTATIVES:

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C. W. Burton Griffiths Co.—London, England
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Send for our big new Illustrated Catalog E. It gives valuable information on better methods of Shop Trucking, Counting of Material, Storage of Material and Inter-communication between executives in different departments.

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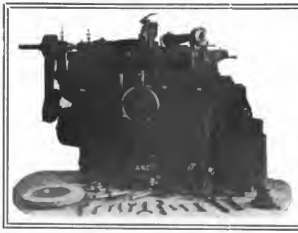
WHY NOT TWO INSTEAD OF ONE?

The Double Spindle Flat Turret Lathe with two chucks and two sets of tools will produce double the output per operator

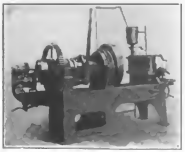
JONES & LAMSON MACHINE CO.
Springfield, Vermont, U. S. A.
109 Queen Victoria Street, London, England



LANDIS TOOL CO.
Waynesboro, Pa.

Manufacturer of all kinds of Precision Grinding Machinery, for grinding all parts of Aeroplane Motors, Marine Motors, Automobile Motors, and Truck Motors, Universal, Plain, Cam shaft, Crank shaft, Ball Race, Roll and Internal Grinding Machines.

Write today for catalogue.



Pipe Cutting
AND
Threading Machinery

THE COX & SONS CO. PHILADELPHIA OFFICE 519-520 Lafayette Bldg. MAIN OFFICE AND WORKS Bridgeton, N. J.

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More Compressed Air Will Help Equalize The Man Shortage

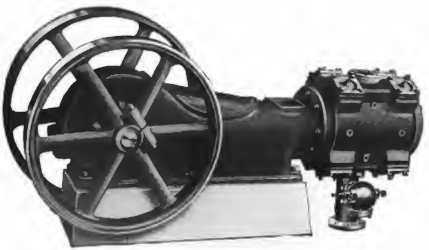
Compressed air power and air tools are a very important factor in meeting the demand for means to replace men no longer available.

Convince Yourself or Give Us a Chance to Convince You

You can place an "Ingersoll-Rogler" Air Compressor in your plant immediately and rest assured that you have the best the market affords—a compressor of modern design, high efficiency, long life and inexpensive operation.

"Ingersoll-Rogler" Air Compressors are being built in quantities, in sizes from 2 to 20 tools, both steam and power driven.

Ask for Bulletins 3031 and 3130.



"Ingersoll-Rogler" Class "ER" Belt Driven Compressor.

INGERSOLL-RAND COMPANY

11 Broadway, New York — Offices the World Over — 165 Q, Victoria St. London

CONDENSING PLANTS AIR LIFT PUMPING

265-C

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CONSTRUCTION

You have no doubt heard of the boy who was asked to describe a gun barrel, and said it was "a round hole with some steel wrapped around it." This made you smile at the time, but really, the conception which most men have of Metal Hose is equally vague. As a matter of fact, manufacturing American Metal Hose is a mighty intricate proposition, requiring the utmost skill and accuracy.

Think what it means to make absolutely pressure-tight Hose from a continuous strip of metal,—Hose that has all the flexibility of rubber and is actually lighter per foot than rubber steam hose.

In designing and perfecting the American Interlocking Construction, we have worked for an ideal combination of strength and suitable flexibility. The illustration above was made from an actual photograph of a piece of 3 4" BD-15 Bronze Hose bent to a 5" radius. Note the even distribution of space where the joints interlock. This secures maximum flexibility, reduces friction on bends, and consequently prolongs the life of the Hose.

THE AMERICAN METAL HOSE CO.

Waterbury, Connecticut

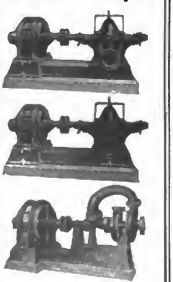
SALES OFFICES

84 Batterymarch St., Boston, Mass., 29 E. Madison St., Chicago, Ill., 173 Lafayette St., New York, N. Y., Union Bank Bldg., Pittsburgh, Pa.
Canadian Selling Agent: Lyth Engineering Co., Limited, Montreal, Can., Pacific Coast Agent: F. Somers Peterson Company, San Francisco, Cal.

QUALITY

In Power Plant Pumps

The bid for popular favor of "American" centrifugal pumps in power plant service is based not alone on high grade material and workmanship but in skillful designing in which ingenious water guidance enables pumps to be made that will operate against high heads with fewest stages, reducing friction losses and maintaining higher efficiencies and flatter characteristic curves.



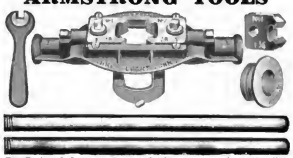
This ability of these pumps to maintain a high efficiency through a wide range of delivery particularly adapt them to many conditions of power plant pumping and this feature should thoroughly appeal to every purchaser of pumps for this purpose.

Catalog 149 describes them.
Write for your copy.

The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First National Bank Building.

ARMSTRONG TOOLS



The Tools of Constant Service—Quality—Accuracy—Dependability

THE ARMSTRONG MFG. CO.
279 Knowlton Street Bridgeport, Conn.

This machine has brought economy and greater efficiency to thousands of warehouses.

There are so many ways in which it may be used that you had better write for full particulars and information.

THE ECONOMY SAFETY FIRST PORTABLE TIERING MACHINE

was originated and is made only by the

ECONOMY ENGINEERING COMPANY

402 So. Washtenaw Ave. Chicago, Ill.

New York Office, 85 Murray Street

Foreign Agents, Brown Portable Elevator Company, Chicago, Ill.

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From Niagara Falls to New York Every Day

—The Travel of the Shaft in an average Johnson Bushing.

Do you realize that the daily travel of the shaft revolving in the average Johnson "Friction-Resisting" Bushing is equivalent to the distance from Niagara Falls to New York City?

Do you realize that this shaft is exerting a pressure, equal to a load hundreds of times the weight of the bushing?

Do you realize the friction which must be resisted by the bushing? No wonder that the making of a bushing is work for specialists.

There are important reasons why we are best fitted to handle your bushing requirements. Write Dept. IM and let us show you what we can do.

JOHNSON BRONZE COMPANY
NEW CASTLE, PA.

Branch Offices
New York Pittsburgh
Detroit Chicago
San Francisco

JOHNSON

FRICTION RESISTING BRONZE BUSHINGS

Portable Work Stand

Nesting Tote Box

Frictionless Bench Drawer

First Aid for Labor Shortage

According to all forecasts the present universal labor shortage will exist for a *long time*. In fact, many authorities predict the *worst is yet to come*.

Prompt action *now* may prevent a collapse of your production program later on.

"NEW BRITAIN" SHOP FURNITURE

is the logical *first aid for labor shortage*. Consider carefully the time- and labor-saving capacity of the items shown here.

They will not literally *replace* men, but they will so *speed up* the efforts of your depleted force as a whole as to *offset* in large measure your loss of workers.

Just check the illustrations which interest you most and mail to us with your letter-head. We will send you catalog describing in detail the full line of "New Britain" Shop Furniture.

What is your address?

The New Britain Machine Company
"Shop Furniture Originators" New Britain, Conn. U.S.A.

Portable Vise Stand

Stacking Tote Box

All-Steel Bench Leg

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Consider This Gasoline Locomotive Crane

if your requirements are such that the expense of a larger steam crane would not be justified.

This crane is particularly adapted to intermittent service, as it uses no fuel except when actually working and no time is required to get up steam. First cost, operating cost and maintenance are all low.

With a grab bucket it will handle ½ ton of coal at a radius of 20 feet, while with a hook it is available for general yard service. It has all the functions of a steam crane and will propel with loaded cars.

Order NOW if you want the crane for use this summer

INDUSTRIAL WORKS, Bay City Mich.

New York Office, 50 Church Street, Philadelphia Office, Widener Bldg.

Sales Agencies: J. G. Miller, St. Louis; C. B. Davis Engineering Co., Birmingham; F. H. Hopkins & Co., Montreal; Northwestern Equipment Co., Portland and Seattle, N. B. Livermore & Co., San Francisco.

Products

Locomotive and Wrecking Cranes, 5 to 160 tons; Pile Drivers; Transfer Tables; Rail Saws; Grab Buckets and Lifting Magnets.

CAST IRON PIPE

WATER SEWER CULVERT

12 Large Stocks Like This Advantageously Placed From The Atlantic To The Pacific Coasts

U. S. Cast Iron Pipe of every description for every purpose. Bell and Spigot, Flanged and Flexible Joint.

We have a fund of data for your consideration. Send for it today.

UNITED STATES CAST IRON PIPE AND FOUNDRY COMPANY

General Offices: 784 E. Pearl Street, BURLINGTON, N. J.

LAMBERT HOISTING ENGINES

ELECTRIC HOISTS CABLEWAYS

FOR MINING, QUARRYING, COAL HANDLING, PILE DRIVING BUILDERS' USE, LOGGING and GENERAL CONTRACTING

SEND FOR E M CATALOGUE

LAMBERT HOISTING ENGINE COMPANY

Main Office and Works:

115-121 PIONEER STREET, NEWARK, N. J.

New York City, 30 Church St.
Seattle, 24 West Connecticut St.
Atlanta, 4th Nat'l Bank Bldg.
Boston, 117 Main St. (Cambridgeport).
St. Louis, 717 North Second St

Chicago, 1156 Monadnock Bldg.
Allegheny, Pa., Lacock and Sandusky Sts.
New Orleans, 217 S. Peters St.
San Francisco, Stewart and Folsom Sts.
Baltimore, 131 S. Howard St.

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A Good Coal Storage System

The Detroit Edison Company handles their storage coal with a number of Brownhoist Locomotive Cranes. Their yard is shown below. The tracks are so laid that every bit of ground can be reached by the cranes and any particular grade of coal can be reached quickly. The coal is piled 15 to 20 ft. high which permits a large storage supply. The top view shows two Brownhoist Cranes with Brownhoist Buckets loading a car to be taken into the plant. On this class of work each crane will handle 90 to 100 tons per hour. Besides handling the coal the cranes do the switching work and other hoisting around the plant.

Brownhoist Cranes were chosen for this work because they are fast, safe and can be relied upon to work continuously. When locomotive cranes are used for this work, you can easily understand that only the best should be used. Breakdowns are disastrous. The Brownhoist may cost more but is worth it.

The Brown Hoisting Machinery Company

Cleveland, Ohio, U. S. A.

Engineers and Manufacturers of Heavy Dock Machinery, Bridge Cranes, etc., as well as smaller Cranes and Hoists

Branch Offices in New York, Pittsburgh, Chicago, San Francisco, and (Portland, Ore., Colby Engineering Co.)

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Here Are Jeffrey Chains That Will Stand the Wear and Tear of the Hardest Service

HERCULES CHAIN

A rugged chain for hard service—used for conveyors and elevators both single and double strand. Economical even for such materials as ashes, coke, sand and gravel, stone, etc. The small sizes make excellent drive chains.

Investigation Will Pay You

More of this kind of helpful information is contained in our Chain Catalog No. 211-F.

It shows many types of Jeffrey Chains; tells about their service application; and has valuable data for Engineers and Contractors.

STEEL THIMBLE ROLLER CHAIN

The highest class of chain for power transmission and apron conveyor service. Suitable also for heavy duty elevators when the very best thing obtainable is desired for handling coal, limestone, etc.

36 years of Chain Building Experience. Let Jeffrey Engineers co-operate with you in planning an equipment to meet your requirements.

THE JEFFREY MFG. CO. 922 North Fourth Street COLUMBUS, OHIO.

PENNSYLVANIA METAL HOSE

Bears Ill Treatment Well

Tread on "Penflex" hose as often as you please, it stays round.

Don't be afraid to use it for hot or cold water, steam or chemicals. They won't hurt it.

30% lighter than rubber, equally flexible, twice as strong and durable.

"Penflex" won the gold medal at the Panama-Pacific Exposition.

Send for our Catalogue and find out why.

Pennsylvania Flexible Metallic Tubing Co.

Cor. Broad and Race Sts., Philadelphia, Pa.

Works: 72nd and Powers Lane, West Philadelphia.

New York, N. Y., 30 Church Street.
Chicago, Peoples Gas Building.
Boston, Mass., 13 High Street.
Cleveland, Rockefeller Building.
St. Louis, Mo., 813 Hempstead Street.

U. S. Flexible Metallic Tubing Co.

Los Angeles, Cal., Cor. Boyd and Omar Streets.
San Francisco, Cal., 68 Main Street.
Houston, Texas, 420 First National Bank Building.
Seattle, Wash., 130 Jackson Street.

ELECTRIC TRAVELING CRANES

NORTHERN CRANES

NORTHERN ENGINEERING WORKS DETROIT, MICHIGAN — U.S.A.

Cranes
Electric Hoists
Air Hoists

Oil Engines Reduce Overhead

IT is entirely possible for us to show you beforehand the saving that will accrue to you by installing a Bessemer Oil Engine. The saving in space required is one item, the lower cost of crude oil is another, and so on. This makes it possible to guarantee results, and to do all this before you obligate yourself to spend a cent. 15 to 180 H. P. Write us about your requirements.

The Bessemer Gas Engine Co.

10 York St. Grove City, Pa.

When making inquiry please mention INDUSTRIAL MANAGEMENT for March

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Berger Steel Lockers

Installed in the new Pennsylvania Taximeter and Service Building

This new ten-story Garage and Service Building is the largest and finest of its type in Philadelphia and probably has no equal in the country. The locker equipment (all Berger Type No. 1011) is distributed on six floors. Our pictures show a part of the Mezzanine floor where 300 Berger lockers are installed.

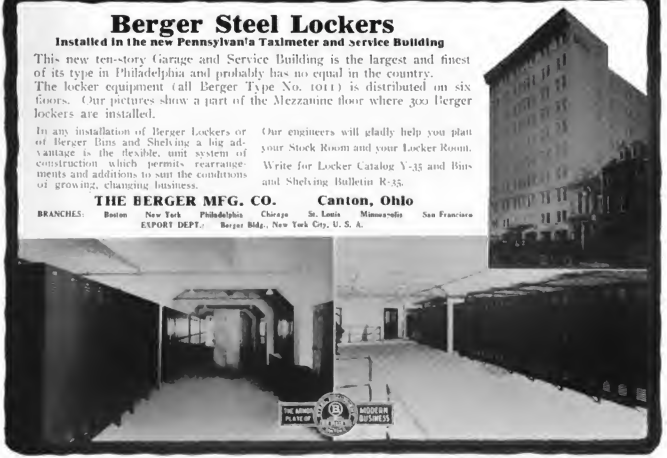
In any installation of Berger Lockers or of Berger Bins and Shelving a big advantage is the flexible, unit system of construction which permits rearrangements and additions to suit the conditions of growing, changing business.

Our engineers will gladly help you plan your Stock Room and your Locker Room.

Write for Locker Catalog Y-35 and Bins and Shelving Bulletin R-35.

THE BERGER MFG. CO. Canton, Ohio

BRANCHES: Boston New York Philadelphia Chicago St. Louis Minneapolis San Francisco
EXPORT DEPT.: Berger Bldg., New York City, U. S. A.



The Simplest Air Compressor and Vacuum Pump

NASH HYDROTURBINE

HERE ARE THE REASONS

Shaft is mounted on high grade annular ball bearings outside of casing.

Note the total absence of valves, pistons, piston rods, crank shafts, loose vanes and gears.

Side thrust is eliminated because compression takes place simultaneously on opposite sides of the rotor (at A and B).

CHARACTERISTICS

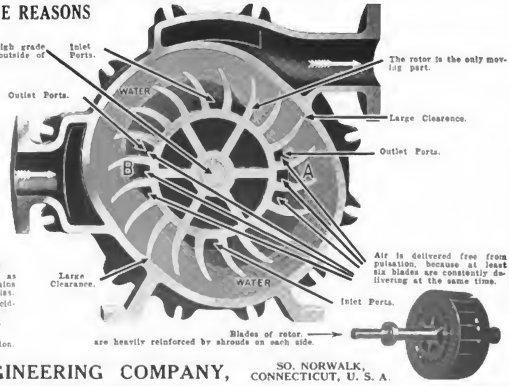
Air is washed as well as compressed, and contains no oil or other impurities.

Can be constructed of Acid-Resisting Metal.

Absolute Reliability.

High Efficiency.

Delivery without pulsation.



NASH ENGINEERING COMPANY, SO. NORWALK, CONNECTICUT, U. S. A.

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Gate fence and fan panels specially designed by us to protect bridge entrance over canal.

There Is No Going "Over The Top" Of An American Chain Link Fence

GOING "over the top" in France is risky business. Going "over the top" of an American Chain Link Fence is more than risky—*it is practically impossible.*

It is equally impossible to *get through it.* It is *man-proof.*

The fencing of practically every factory presents its own peculiar problems. In determining upon the most effective and economical way in which to meet each requirement the services of our Engineering Department will be found of great value.

The illustration above shows how a troublesome foot bridge entrance was effectually fenced; the arrangement being worked out by our engineer while looking over the ground.

Put *your* fencing problems directly up to us. We will give them our most careful consideration and make recommendations as to the most logical solution.

This service will cost you nothing and obligate you not at all.

Catalog is yours for the asking.

American Fence Construction Co.

104 Church Street New York City

Prison Sash Operated By Lord & Burnham Apparatus

In New Women's Wing of the Essex County Penitentiary at Caldwell, N. J. Each panel contains 5 sash 12 on floor above). Each panel operates as a unit. Rocker Shaft apparatus used. Send for catalog. It will help you in *your* sash-operating problems.

Lord & Burnham Co.

IRVINGTON, N. Y.

HITCHINGS'

Sash Operating Apparatus

NO matter how many or what kind of sash — whether hinged or pivoted—their size, weight or position—all are operated and regulated perfectly by our apparatus.

There is no clogging—no jamming of the gears—the control from any point is positive.

HITCHINGS & CO., Elizabeth, N. J.

ATMOSPHERIC, CHIMNEY and FORCED DRAFT TOWERS

Spray Nozzle Installation

THE COOLING TOWER CO.

17 John Street NEW YORK CITY

COOLING TOWERS FOR ALL SERVICES

(Forced Draft, Combination, Natural Draft and Atmospheric Cooling Towers)

GEORGE J. STOCKER, Patentee and Manufacturer

ST. LOUIS, MO.

Corner Odell St. & Kingshighway. *Write for catalogue No. 3*

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Saving Fuel? Yes! Decreasing Production? No!

Conservation of fuel does not necessarily mean that production need suffer. In fact, fuel may be saved and production often increased by eliminating radiation losses from furnaces, boiler settings, blast mains, etc.

As an example of the efficiency of Nonpareil Insulating Brick in stopping radiation loss, take an over-fired heat treating furnace, 7' 9" wide by 9' 1½" high by 8' long, working twelve hours per day, 300 days per year. With an inside temperature of 1600° F. and the outside air at 100° F., the loss, if the furnace were **not insulated**, would amount to approximately 627,435,000 B.T.U. per year.

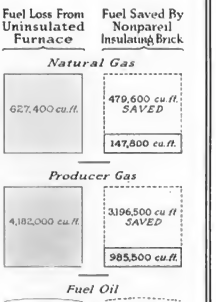
Now, if one 4½-inch course of Nonpareil Insulating Brick were installed in place of a like amount of fire brick or common brick, the radiation loss would be reduced to 147,835,000 B.T.U.—**with no decrease in output.**

At the present prices of fuel, the return from the Nonpareil Brick would be considerably more than 100 per cent on the investment.

Saving fuel is one of your most important problems. May we help you? All the information gained through many years' experience in this field is at your disposal, without charge or implied obligation.

Armstrong Cork & Insulation Co., *128-24th St., Pittsburgh, Pa.*

Also manufacturers of Nonpareil High Pressure Covering for steam lines; Nonpareil Corkboard Insulation for cold storage rooms; Nonpareil Cork Covering for drinking water systems; Nonpareil Cork Machinery Insulation for deadening the noise of machines; Circle A Cork Brick for cold storage rooms; and Linotile for floors in offices, residences, etc.



Nonpareil Insulating Brick

For Furnaces, Boilers Settings, etc.

In Continuous Operation Since 1897

That's the record of the Hughes Mechanically Poked Gas Producers, first built for the Pencoyd Iron Works Pencoyd, Pa.

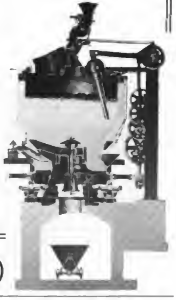
Twenty Years of Profitable Service from

THE HUGHES MECHANICAL GAS PRODUCER

That same company, the Pencoyd Iron Works, has at different times since 1897 ordered **fourteen** additional Hughes Producers. The main principles embodied in the first Hughes Producer are identical with those distinguishing the type of today—Uniform Feed, Uniform Mechanical Poking, Uniform Blowing and Mixing, all combining to produce a Uniform Volume and Flow of Gas.

More than One Thousand Hughes Producers are now in use in the United States and foreign countries. One user has one hundred and nineteen! Eighty-five **repeat** orders, calling for a total of four hundred and twenty Hughes Producers, have been received.

We can't tell you all about the good points of the Hughes Producer here but would appreciate talking with you further through our Bulletin No. 4. SEND FOR BULLETIN.



The Wellman-Seaver-Morgan Co., CLEVELAND, OHIO, U. S. A.

Other Products of the W-S-M Company: Charging Machines, Manipulators, Furnaces and other Steel Plant Equipment; By Product Coke Oven Machinery; Shipyard Cranes; Hoisting and Mining Machinery; Ore and Coal Handling Machinery; Special Large Cranes; Hydraulic Turbines and Valves

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RELIABILITY EFFICIENCY EXPERIENCE

Lord Electric Co.
Incorporated 1895

CONTRACTING
ELECTRICAL
ENGINEERS

$500,000 CAPITAL
Backs Our Service

NEW YORK BOSTON
BALTIMORE WASHINGTON

REILLY WATER HEATERS
Make Coal Go Further

Heat feed water with exhaust steam instead of coal. Leave the boiler free for its legitimate business — *generating steam.*

Prevent strains incidental to turning cold water into a hot boiler.

HANDY and HARDY

Take little space. Light and easy to install.

Every coil a spring to take up expansion strains.

Look at the big door in front!

It provides access to the interior of the shell for inspection.

Coils are interchangeable.

Turn your exhaust steam into money. Bulletin 230 tells how.

THE GRISCOM-RUSSELL CO.
2139 West Street Building, New York
Boston Philadelphia San Francisco Chicago

"Zones of Quiet"
Accurately Generated
GEARS

Wherever you find Albaugh-Dover Accurately Generated Gears in use, you are sure to be impressed with their unusual smoothness and silence in operation. Our Gears are used by many of America's leading manufacturers of Automobiles, Trucks, Tractors and other machinery. If you use gears—SPIRAL, BEVEL, INTERNAL, WORM OR WORM WHEELS, send us your blue prints or sample gears for estimates. We operate our shops continuously day and night in three shifts of 8 hours each, insuring exceptional service.

Albaugh-Dover Co.
2100 Marshall Blvd.
Chicago, Illinois

TROY ENGINES SAVE
STEAM — OIL — WEAR

Balanced Valves that are steam-tight and durable, preventing leakages and breakdowns;

Long Connecting Rods that lessen friction on the guides, conserving power and prolonging the life of the bearings;

Patent Locking Device for the crankpin bolts, making accurate adjustment easy and securing against accidents;

and a patented Self-oiling System that lubricates the bearings with an abundant flow of oil, circulating under slight pressure and stopping and starting with the engine

are four major features (there are many lesser ones) that make the Troy Engine a prime mover that develops power at a low price and stands up under hard service.

Our quarter of a century's experience in building "ONLY STEAM ENGINES—GOOD ENGINES ONLY" is at your service for the asking.

Write for Catalogue C. E. and find out how.

TROY ENGINE & MACHINE COMPANY
TROY, PA.

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The maker's name tells who made the lamp; the mark MAZDA tells exactly what standard of excellence governed its making.

MAZDA

"Not the name of a thing, but the mark of a service"

The Meaning of MAZDA

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this Service. MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, New York. The mark MAZDA can appear only on lamps which meet the standards of MAZDA Service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.

RESEARCH LABORATORIES OF
GENERAL ELECTRIC COMPANY

4636

When making inquiry please mention INDUSTRIAL MANAGEMENT for March

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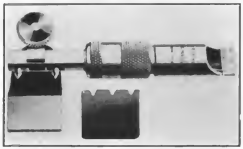
B-T
THREAD LEAD INDICATOR



Tests Threads of Odd Pitch As Well as Even

A B-T Thread Lead Indicator will test the lead on internal and external threads of even pitch or odd. Tapped holes as small as ½" in diameter can be tested by merely removing the table under the gaging points. A special master gage for setting the indicating points makes testing of odd pitches easy.

Ask for the details.

BICKNELL-THOMAS CO.
Greenfield, Mass.

Three Good Things To Remember

"CRESCENT" Thermometers

"COLUMBIA RECORDERS"

"S & B" Efficiency Promoting Instruments

Just remember the names. If you get them right you may be sure the instrument is right—right in design, construction and results.

An experience of nearly seventy years, a complete line to choose from, and specialists to advise with you on the selection of the most suitable type of instrument for your needs are three things not only to remember but to take advantage of when you are in the market for Efficiency Promoting Instruments.

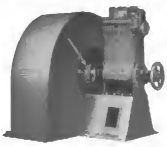
Right now you can write for Catalogue Set E.M.

THE SCHAEFFER & BUDENBERG M'F'G CO.
BROOKLYN, N. Y.
Chicago Pittsburgh
St. Louis Philadelphia

OUR NEW PLANT

Largest and best equipped factory in the world for manufacturing Automatic Tobacco Machinery. Also builders of high grade special and automatic Machinery
Jigs, Tools, Gauges and Fixtures

American Machine & Foundry Company
Main Office and Factory: 5520 Second Avenue, Brooklyn, N.Y.
New York Office: 511 Fifth Avenue, New York



One Remedy for the Fuel Famine

is to make sure that there isn't the slightest waste of power in your plant. You are wasting power if you have shaft connections and are not using

Clark Flexible Coupling

Represent the maximum of economy and efficiency.
Used by industrial establishments famous for their efficient management.
It will pay you to find out why.

I. H. DEXTER COMPANY, Inc.

Darling Bros., Ltd., Montreal, Que., Can. **FLEXIBLE COUPLINGS** 27 Walker St., NEW YORK CITY

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Tool Room, Dodge Brothers, Detroit, Mich., Illuminated by Cooper Hewitt Lamps.

Status Quo Ante Bellum

THE "Status Quo Ante Bellum" will never again return in our industrial methods and ideas. American inventive genius is being forced to the front all along the line. Science is taking its rightful place as the basis of all manufacturing processes.

The old idea that labor cannot produce efficiently under artificial light is being thrown into the discard along with the divine right of kings. The great modern industries, the making of automobiles, warships, munitions, textiles, are now being carried on by Cooper Hewitt Light with results equal in every respect to those obtained under the best daylight conditions.

The thousands of workers who have been put on night shifts, as a war measure, are going to find that working under Cooper Hewitt Light is just as satisfactory as working by daylight, and in future they will insist on having their leisure in daytime, for at least a portion of the year.

And it will be a gain to both labor and capital.

BETTER THAN DAYLIGHT

Cooper Hewitt Electric Company

General Offices and Works, 8th and Grand Streets, Hoboken, N. J.

Boston Chicago Cincinnati Cleveland Detroit Philadelphia Pittsburgh St Louis

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KELLY
Production Tools

for Cylinders, Crank Cases, Connecting Rods, Auto Parts, Etc.

We make DELIVERIES in 1 to 10 days

They "ADJUST"

Write for the Catalog G-E

THE KELLY REAMER CO.

CLEVELAND, OHIO, U. S. A.

C. W. Burton, Griffiths & Co., London, English Agents
Burton Fils, Paris, French Agts. 40 Domestic Agencies.

EDWARDS ROLLING STEEL DOORS Will Protect Your Buildings

Handle Operated

From fire and the contents from theft. They are made of heavy special cold rolled steel, bright or galvanized. Patented Spring Release Mechanism causes doors to close automatically in case of fire. Doors have been designed and successfully operated for openings of all sizes up to 40 feet wide and over 100 feet high.

Our Engineering Department will gladly submit designs and specifications to fit your special needs.

Chain Gear Operated

Write today for Catalog.

The Edwards Mfg. Co.

Lester G. Wilson, Cons. Engr.
317-347 Eggleston Avenue
Cincinnati, Ohio

Metal Roofing—Portable Buildings—Steel Lockers—Shelving—Bins, Etc.

CALDWELL GEARS

Cut Teeth
Spur Bevel Miter
Mortise Wheels
Send for Catalog 38

CALDWELL

Cast Teeth
Cast-Iron-Bronze
Semi-Steel and
Cast Steel

H. W. CALDWELL & SON CO.

CHICAGO: 17th St. and Western Ave. NEW YORK: Fulton Bldg., 50 Church St.
DALLAS, TEX.: 709 Main St.

Rugged and Reliable

O & S CLAM SHELL ORANGE PEEL BUCKETS

are just the thing for excavating in rock, rubble and old brick and stone walls. The points of our clam shell buckets, of manganese steel riveted to the scoops, bite into hard materials without breaking or blunting.

The engineer appreciates a bucket he can depend upon to equal or better the estimates on his progress chart. The craneman likes to operate one he can push without danger of a breakdown.

Catalog No. 11 shows the wide range of uses to which O & S Clam Shell and Orange Peel Buckets and Locomotive Cranes can be put.

Orton & Steinbrenner Co. Main Office, 610 Dearborn Street, Chicago, Ill. WORKS Huntington, Ind.

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Sturtevant APPARATUS

(REG. U.S. PAT. OFF.)

WILL HELP

When the Eagle Strikes

The Eagle Is Sharpening His Claws

SOON HE WILL BE READY TO POUNCE. AND WHEN HE DOES——!

The largest destroyer fleet in the world.—A hoard of thousands upon thousands of airplanes.—A shoal of grimly efficient submarines.—A great battleship building program will place the United States squarely in the forefront of all the nations. The stupendous resources of the richest and strongest nation in the world are now being solely concentrated upon one thing—preparation to speedily and victoriously end the war.

AND WE ARE HELPING. Wherever the American flag flies—on battleship, on submarine, on airplane, in the vast workshops where the nation's store of munitions is being gathered —there you will find STURTEVANT APPARATUS. Uncle Sam tested it and found it good.

Sturdiness, reliability and superiority of service are the features which recommended Sturtevant to the Government. These qualities should make them appeal also to you.

Our general catalog is yours for the asking

B. F. STURTEVANT COMPANY, Hyde Park, Boston, Massachusetts
And all Principal Cities

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Counting Production is a Basic Wage-Principle

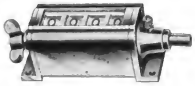
You know more ways than one to get more work from operatives, but behind most methods is the basic idea of *increasing wages* for *increased production.*

Whether you pay by piecework, by a bonus plan or the "task" system, the incentive-principle is the same—and the necessity of *counting production* is the same.

You get accurate counts of production—correct records of wages due—for operating any machine equipped with a

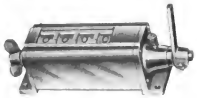
Veeder COUNTER

The production-figures of the Veeder are plain to employer and employee alike; they eliminate all dispute as to earnings; their absolute fairness leads to better relations with help. Below you'll see two widely adaptable models:



This Revolution Set-Back Counter registers one for each revolution of a shaft, recording a manufacturing operation. Set back to zero by turning knob once around. Supplied with from 4 to 10 figure-wheels, as required; also with lock and keys to prevent tampering by employees. Price (without lock) $8.00 (subject to discount). With lock and two keys, $1.50 extra.

The Rotary Ratchet Counter below counts *reciprocating* movements instead of revolutions: the counter for punch presses, metal-stamping machines, etc. Reset to zero by turning knob, and furnished with any number of figure-wheels up to ten. Price (list), $9.50. With lock and keys, $1.50 extra.



You'll find the FULL answer to your counter needs in booklet we'll gladly send on request.

The Veeder Mfg. Co.
46 Sargeant St., Hartford, Conn.

At  **Last!**

we are again able to supply the incomparable

Adjustoglas

Super-Safety Goggles

with the NEW accident-proof "Resistal" Reinforced Lenses

Mounted in an improved new frame of remarkable simplicity—the only goggles that actually lift a load of worry and responsibility from an employer because of their unquestionable protection.

Used by the government in gas masks and aviators' goggles.

Write today for information and a demonstration lens of Resistal Glass.

Have you our catalog?

The Strong, Kennard & Nutt Co.
Goggles, Safety Devices and First-Aid Supplies
2044 East 9th Street, Cleveland, Ohio

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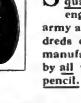
17 black degrees
6B softest to 9H hardest
and hard and medium copying
All perfect!



SET the world standard for quality. Used by designers, engineers, draftsmen and army and navy officers in hundreds of munition plants, in manufactories, shops, etc., and by all who need the very best pencil.

FREE!

This trial box with five VENUS Drawing Pencils, and VENUS Eraser sent FREE! Please send 6c in stamps to cover packing and postage.

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American Lead Pencil Co.
210 Fifth Avenue, New York
and Clapton, London, England

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Buick
MOTOR CARS

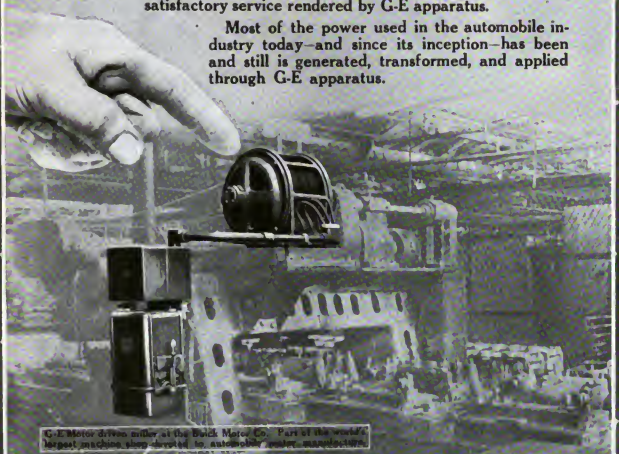
HOME OF THE BUICK CAR – FLINT, MICH.

G-E Equipment Helps Build Most American Automobiles

Buick Valve-in-Head Motor Cars are built in one of the largest and best equipped factories in the world.

For this factory G-E motors and control equipment were selected. Repeat orders have continually testified to the satisfactory service rendered by G-E apparatus.

Most of the power used in the automobile industry today—and since its inception—has been and still is generated, transformed, and applied through G-E apparatus.



G-E Motor driven miller at the Buick Motor Co. Part of the world's largest machine shop devoted to automobile motor manufacture.

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GE

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How Goodyear Makes Its Men Available

Goodyear tires are used by thousands of motorists. Goodyear rubber goods are used in millions of homes.

Back of Goodyear products is a tremendously big organization with exceptional facilities for determining the merit of time-saving appliances.

The very fact that they are using the Autocall would indicate that the sturdy little "Mechanical Finder of Men" is proving valuable in their business.

THE MECHANICAL FINDER OF MEN
Autocall

In this busy plant, with its acres and acres of floor space, the Autocall is kept right on its toes every minute of the day.

It keeps tab on more than forty important people, making available, right on the dot, such men as superintendents, foremen, master mechanics and others.

Goodyear executives find in the Autocall a sense of security, realizing that it will "page" them instantly in case they are wanted when away from their desks. Wherever they go, in any part of the plant, The Autocall follows them with a watchful eye.

Your plant may be larger than Goodyear's, in which case the Autocall will cost you more. If smaller, the cost will be less. In either case the saving will be in proportion to the amount invested.

Our unique plan of demonstration has enabled hundreds of Autocall users to determine how much they would save by using this service before they invested a single dollar.

May we put the details of this plan before you?

The Autocall in Use

Autocall Fire Alarm Service

The Autocall may be furnished as a "Dual" calling and interior fire alarm service. This renders the Autocall doubly valuable as it serves two distinct purposes. The cost of such a system is small as compared with that of two separate systems being but slightly more than the single cost of either Autocall or fire alarm service.

THE AUTOCALL COMPANY, Shelby, Ohio

"Silver Genuine" BABBITT

occupies the enviable position of being the best Babbitt Metal manufactured.

Strict adherence to formula, selection of best materials and careful supervision of manufacture has enabled us to keep the quality uniform for the past thirty years.

Send for our prices.

We can quote on all grades of Babbitt or other Mixed Metals.

Also Manufacturers of
Evans "Almetl" Fire Doors
Fire Retarding "Star" Ventilators
"Merchant's Old Method" Roofing Tin

MERCHANT & EVANS Co
NEW YORK PHILADELPHIA WHEELING
BALTIMORE CHICAGO
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for

Bituminous Slack—Fine Grades of Anthracite—Coke Braize—

Water Cooled Grates. Simple. Efficient.

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Accuracy and Simplicity are the keynote of the 'Buff's' past record for many years.

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STENCILS-BURNING BRANDS
STEEL STAMPS & DIES
SEALS-MACH. PLATES-CHECKS
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Standardization Accuracy Speed

These three qualities are not only desirable but absolutely essential to the quantity production era upon which our manufactories have been forced by present conditions.

But these qualities are possible only through the use of proper gages and gaging systems.

In this connection it is well to remember that G.T.D. Gages with their sealed adjustments and other features are the product of Gage Specialists and were not evolved on the spur of the moment to meet an abnormal demand.

Write for complete information.

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TAPS—DIES
SCREW PLATES
GAGES
REAMERS—
—PIPE TOOLS
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Six Carrier Generator Filters remove approximately twenty pails of dirt a month—each.

For Specific information write Department 21.

Carrier Air Conditioning Company
of America
Buffalo, N. Y.

Once or Ten Thousand Times
Steam Trap SARCO

Functions with Equal Positiveness and Reliability

There is an advantage in a steam trap whose actuating mechanism is isolated from destructive agencies. The impelling force in Steam Trap Sarco is a heavy hydro-carbon oil, hermetically sealed in a strong tube. *Exclusion of air and impurities makes evaporation, decomposition or deterioration impossible.* Therefore Steam Trap Sarco is always equally strong, sensitive and reliable.

With coal hard to obtain—you need every pound of steam your boilers produce. Steam Trap Sarco prevents losses and at the same time keeps pipes drained.

Steam Trap Sarco never freezes.

Made in all sizes, ¾" to 3". For Steam pressures up to 200 lbs.

Write for Bulletin H-19

SARCO COMPANY, Inc., Woolworth Bldg., New York

PHILADELPHIA CLEVELAND DETROIT CHICAGO
BUFFALO MONTREAL

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What Covers Your Roof?

HOW careful we are, when we build, to select the brick, for example, the lumber, the paint and the hundreds of other materials that go into the structure.

But the roof—when it comes to the roof, somehow we are not so careful. The average building owner does not give sufficient consideration to the material that covers his roof. And in most cases he does not even know what is used. The result is high upkeep expense.

Some roofings corrode, some melt, some dry up, crack and are inflammable. But Toncan Metal Roofing in actual service is corrosion-resisting, it won't dry up, melt, crack or burn.

Therefore, if you would economize, use Toncan Metal Roofing (procurable in many forms).

Write for "Corrosion—the Cause—the Effect—the Remedy"

Jobbers and Sheet Metal Contractors everywhere sell Toncan Metal

The Stark Rolling Mill Co., Canton, Ohio

TONCAN METAL

Resists Corrosion

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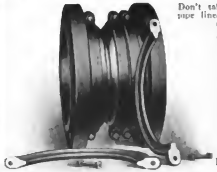
OVERHEAD DRILLING

The modern way of doing overhead drilling with a REVOLVATOR or Portable Elevator, saves time and labor and is safe.
The workman and drilling outfit may be elevated on the platform of the Revolvator to the place where the drilling is to be done in one, or two minutes.
The REVOLVATOR used for this work may also be employed for erecting overhead motors, taking them down for repairs and also for piling cases, barrels, bales, etc.
Write for Bulletin E48
N. Y. Revolving Portable Elevator Co., 247 Garfield Ave., Jersey City, N. J.

BADGER JOINTS PREVENT LEAKS



Don't take leaks in your pipe lines as a matter of course. Badger Expansion Joints by absorbing expansion strains, absolutely prevent them. Badger Joints work automatically—requiring no packing or adjustment when once installed. They will save you *time, trouble* and *money.*
Write for Catalogue No. 1.
E. B. BADGER & SONS CO.
Boston, Mass.

Why Take a Chance?

Why not specify the best? If you are in the market for Flexible Couplings, and want something which is unusually strong, silent, flexible, simple, and moderate in cost, then you must order

FLEXO COUPLINGS

There may be some cheaper—there can't be any better! Don't take our word for it, but send for catalog No. 17-F, and be convinced!

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The OIL paint with a glossy, tile-like, white finish. Made by a special process over which we have exclusive control. Contains no varnish. Its firm, yet elastic, surface will not crack or scale, for it expands and contracts with temperature changes, and withstands vibrations.

RICE'S MILL WHITE
(Barreled Sunlight)

The original "Mill White." It increases your daylight 19% to 36% by actual tests. Reflects every ray of natural and artificial light. Reduces your lighting bills. Resists dirt. Is sanitary and can be washed clean when other paints need re-coating. Remains white long after other paints have turned yellow under the same conditions.

For all interior use in shops, factories, stores, restaurants, etc.

Sold in barrels, also in cans; made in Gloss, Egg Shell and Flat.

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You will always find
NELSON VALVES
"a safe valve investment"
NELSON VALVE CO. CHESTNUT HILL, PHILADELPHIA, PA.

The HELWIG Close Quarter Flat Air Drill Reversible for Metal and Wood Boring.

Exceedingly convenient for work in narrow and confined places and close in corner or wall, as also for general purposes.
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Valveless, eliminates many parts found necessary in other piston-type Air Drills. Gear-driven spindle.
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HELWIG MFG. CO. St. Paul, Minnesota

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PEAK OF PERFECTION APPARATUS

What with coal, labor, and freight embargo troubles there are too many interruptions to power service now without piling on the extra burden of unreliable apparatus.

RIDGWAY Motor-Generators

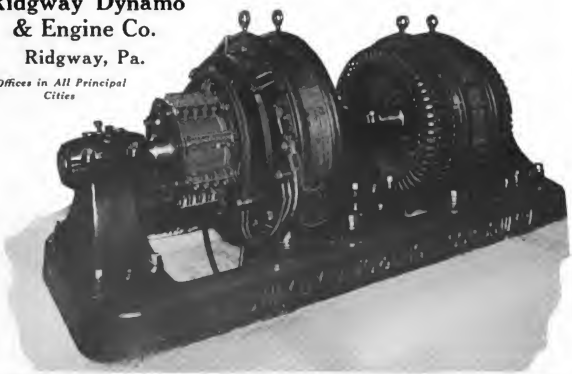
have always given service that squared up with the implications laid down in their rigid specifications.

Their high overload capacity and low operating cost make them at all times a truly economical purchase. And now when overloads are the rule and competent help scarce their purchase is doubly justified.

Engineering Service or Literature on Request.

For *Uninterrupted* Power Service

Ridgway Dynamo & Engine Co.
Ridgway, Pa.
Offices in All Principal Cities



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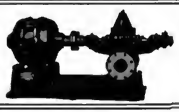

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Builders of Dredges, Centrifugal Pumps, Pumping Engines

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The LAWRENCE CENTRIFUGAL PUMPS

Are standard the world over for all sorts of conditions and service.

Our thirty-five years' experience is worthy of your attention.

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THE McDANIEL IMPROVED STEAM TRAP

Discharges Continuously and Never Blows Steam. Made Extra Heavy for High Pressures

All working parts are here

Quick and easy to repair

No pipe connections are broken when making repairs, all steam pipes being attached to body.

We also manufacture Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

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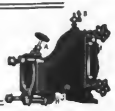

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STEEL PLATE WORK AND STEEL TANKS
For Every Purpose

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We have them in stock or will make them promptly
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Carrying Materials Piecemeal Wastes Labor—Time—Money

The coal famine is an illustration of the results of piecemeal handling—a glut at the source and a shortage where needed. The transportation of oil goes forward as usual, helping to alleviate the coal famine, because oil is largely transported by pipelines—in a continuous stream—the transportation assisted by nature's basic force—**gravity.**

MATHEWS GRAVITY ROLLER CONVEYERS

give the same "straight line flow" for packages that pipe lines give for oil. They carry boxes, bags, barrels, etc., around corners, over obstacles, from floor to floor, from building to building. The coal famine don't effect them—operated by gravity only.

Clear floors—speedy handling—prompt loading and lower payrolls are a few of the advantages offered.

Used in the largest munition plants in the country and many nationally known manufacturers—whose names will be furnished on request.

Our engineers have adapted Gravity systems to the specific requirements of hundreds of concerns during the last fifteen years. They can do as much for you.

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Ellwood City, Pennsylvania

BRANCH FACTORIES:

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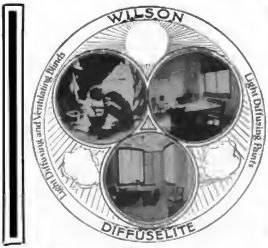

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Every important article published in the engineering press of the world—every important paper read before the technical societies of the world—is indexed in our Engineering Index. These articles can be procured at small cost through our Index Department—see Explanatory Note page 248 for full details.

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IN STOCK AND TO ORDER

Diamond, Whitney, Baldwin, Duckworth, Culver Taylor, Jeffrey and Coventry Chains, Block, Roller and High Speed Silent types on hand.

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NILES CRANES

Built In Any Size Required

Niles Electric Traveling Cranes are designed to obtain the highest operating efficiency with the lowest cost of maintenance. They are of liberal design, allowing an ample factor of safety throughout. Built to operate continuously, all problems of maintenance and repairs have been successfully solved. All parts for units of same size are interchangeable and are readily accessible for examination or removal.

Write For Our Crane Catalog

NILES-BEMENT-POND CO.

GENERAL OFFICES, 111 BROADWAY, NEW YORK

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CHICAGO ST. LOUIS BIRMINGHAM, ALA. SAN FRANCISCO

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POWER—PUNCH—PEP

in your business depend upon your grip on details. You can secure it without leaving your office or wasting your time by installing

Stromberg-Carlson Inter-Communicating Telephones

Instant, direct communication with any department secured by **pressing one button once.**

No switchboard or operator. Always ready for service. Costs no more to operate and maintain than a push button and buzzer system.

Furnished in 6—12—22 and 32 station sizes in either wall, desk or combination telephone equipment.

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ROCHESTER, N. Y.
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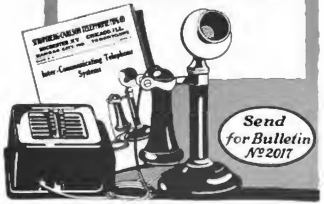

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ASBESTOS PACKED COCKS

For more than two-score years "P & C" Valves and Asbestos Packed Cocks have merited the confidence of the leading engineers of the country. This confidence was built up solely on performance—the one thing we are particular to have our trade mark stand for.

P&C CO P&C CO

PRATT & CADY CO. INC.
HARTFORD, CONN.

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EASTON INDUSTRIAL RAILWAY CARS

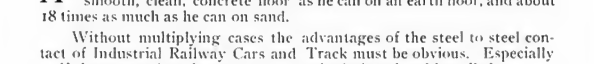
Obvious Advantages

A MAN can handle twice as much material in a wheelbarrow on a smooth, clean, concrete floor as he can on an earth floor, and about 18 times as much as he can on sand.

Without multiplying cases the advantages of the steel to steel contact of Industrial Railway Cars and Track must be obvious. Especially so if the cars and equipment are properly designed and installed.

This Company's quarter-century of manufacturing specialization and the services of its engineering force will assure for you the highest type of Industrial Railway.

EASTON CAR & CONS'T'N CO.



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American Gas Furnaces and Heating Machines

have set the Standard for 40 years

Heating Machine to Temper Colors—Gun Metal or Carbonia Finish

A MACHINE FOR EVERY USE We manufacture a great variety of Furnaces and Heating Machines, *each guaranteed to do the work recommended. Write for catalogue.*

Even fuel consumption—quick and uniform heat—proper combustion—no excess of air is secured by our method of burning gas. Saves your gas bills—saves spoilage.

Annealing, hardening, case hardening, tempering, coloring, brazing, etc., are critical operations, whose success depends absolutely upon the accurate regulation of heat. With metals and labor high-priced and scarce, warped, scaled and burned pieces are most expensive than perfect apparatus.

Speed in attaining the temperature required—precision in maintaining it are secured by the use of American apparatus. Perfect products, quick production, fuel economy and cleanliness are the results.

Temperature may be regulated at the will of the operator or our Automatic Heat Controller will prevent a variation of more than 5° F. from the temperature to which it is set.

AMERICAN GAS FURNACE COMPANY

24 JOHN STREET, NEW YORK

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Do You Want A Man Like This?

"Dear Dr. Blackford," he writes, on February 2, 1918, "you remember me as the young man who traveled more than a thousand miles, by telegraph appointment, to gain an analysis from you on June 15th of last year. You mentioned advertising as being congenial to my aptitudes.

"Your advice was followed. The profession was fascinating, progressive and congenial, as you had advised. My advertising ideas attracted extensive attention, with the result that I was appointed assistant advertising manager of the ——— ——— Company (a concern doing national advertising on a large scale). For two months I have been successfully serving in that capacity."

You may need an assistant advertising manager, or superintendent, or sales manager.

Perhaps you are searching far and wide for him, when just the man you want is in your own organization.

This young man's former employer did not suspect that the youth had any such capacity. The young man himself was at least uncertain about it.

And yet, within eight months, he holds a position so important that you see the results of his work in nearly every magazine you pick up.

We are finding such men for our clients, in their own organizations.

We can do it for you.

Full particulars upon request.

Dr. Katherine M. H. Blackford

Employers' Adviser : *Suite 1927*

50 East 42nd Street, New York

10 HAMILTON "GASTEAM" ENGINES

Helping Ford Produce A Submarine Chaser Daily

SPEED *must be* the keynote in building the fleet that will "get" the U-boats. SPEED has been the keynote of the Ford policy. SPEED depends upon perfect organization and equipment.

The Ford Engineers selected *Hamilton "Gasteam" Engines* because they combine the high efficiency of the gas engine with the reliability and close regulation of the steam engine. Special devices utilize the waste heat from the exhaust gases and jacket cooling water.

They are doing their full share *"To make the world safe for Democracy."*

THE HOOVEN, OWENS, RENTSCHLER CO.

HAMILTON-CORLISS ENGINE WORKS

Offices in All Large Cities

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PATENTS AS A FACTOR IN MANUFACTURING

By Edwin J. Prindle

THIS book, the work of one of the leading patent lawyers of the country, does not aim to make the manufacturer his own lawyer but to open his eyes to what it is possible to do in connection with patents, not for the purpose of his doing it unguided by legal advice, but to suggest to him to what ends to ask such advice. There are many manufacturers who could and would strengthen their position commercially through patents if they but saw the neglected material at hand, or understood the fuller possibilities of material of the availability of which they are already partially aware.

Patents are the only legal form of absolute monopoly and yet many—in fact most—owners of patents and of patentable inventions do not fully understand what their rights are under their patents.

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It is unnecessary for us to enlarge on the importance of the subject which the book treats. What you want is to know just how this book will add to your equipmenut as an industrial executive. Therefore let us send it for your examination—look it over a week, study its application to your work and then—if you wish—send it back without obligation of any kind. Otherwise just send us two dollars ($2.00) in payment at your convenience within thirty days.

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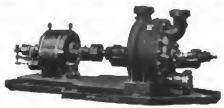

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Gunn, Richards & Co., New York, N. Y.
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Aero Pulverizer Co., New York.

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General Electric Co., Schenectady, New York.
Ingersoll-Rand Co., New York.
Nagle Corliss Engine Works, Erie, Pa.
Nash Engineering Co., S. Norwalk, Conn.
Norwalk Iron Wks., Norwalk, Conn.

Air Drills.

Ingersoll-Rand Co., New York.

Air Hoists.

Hunt & Co., C. W., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.

Air Receivers.

Graver Tank Works, Wm., Chicago.
Scaife & Sons Co., Wm. B., Pittsburg.
The Continental Iron Wks., Brooklyn, N. Y.

Air Separators.

Bennett Co., Clinton, O.
Jeffrey-Bement Co., New York, N. Y.
Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

Air Washers and Humidifiers.

Carrier Air Conditioning Co., New York.
Sturdevant Co., B. F., Boston, Mass.

Alarms, High and Low.

Foxboro Co., The, Foxboro, Mass.
Taylor Instrument Cos., Rochester, N. Y.

Alternators.

General Electric Co., Schenectady, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Westinghouse Electric & Mfg. Co., Pittsburgh.

Ammeters.

General Electric Co., Schenectady, N. Y
Johns-Manville Co., H. W., New York.
Westinghouse Electric & Mfg. Co., Pittsburgh.

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Lubricating Metal Co., New York, N. Y.
Merchant & Evans Co., Philadelphia, Pa.
Phosphor Bronze Smelting Co., Phila.

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American Mach. & Fdy. Co., Brooklyn, N. Y.

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Auburn Ball-Bearing Co., Rochester, N. Y.
Fafnir Bearing Co., The, New Britain, Conn.
Norma Co. of America, New York.
S. K. F. Ball Bearing Co., Hartford, Conn.

Balls, Brass and Steel.

American Ball Co., Providence, R. I.

Bearing Metals.

Lubricating Metal Co., New York, N. Y.
Phosphor Bronze Smelting Co., Philadelphia.

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Johnson Bronze Co., New Castle, Pa.
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Bearings, Die Cast.

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Bearings, Roller.

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Norma Co. of America, New York.
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La Belle Iron Works, Steubenville, O.

Bins, Steel.

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Kennedy, Walter, Pittsburgh.

Blooms.

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Terry Steam Turbine Co., Hartford, Conn.
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Cooper Hewitt Electric Co., Hoboken, N.J.

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Powell Co., Wm., Cincinnati.

Boilers.

Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., New York.
Scaife & Sons Co., Wm. B., Pittsburgh.
Smith & Son Co., Samuel, Peterson, N. J.
Wickes Boiler Co., Saginaw, Mich.

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Bolt and Nut Machinery.

Greenfield Tap & Die Corporation, Greenfield, Mass.
Niles-Bement-Pond Co., New York.

Boosters, Electric.

General Electric Co., Schenectady, N. Y.

Boring Mills.

Niles-Bement-Pond Co., New York.

Boring Tools, Adjustable.

Isaly Bauser Co., Cleveland, O.

Brakes, Magnetic.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Brakes, Friction.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Brass Makers' Lathes.

Niles-Bement-Pond Co., New York.

Brick, Fire.

Maurer & Son, Henry, New York.

Brick and Tile Machinery.

Bonnot Co., Canton, O.

Bridges, Roofs, etc.

Scaife & Sons Co., Wm. B., Pittsburgh.
Wellman-Seaver-Morgan Co., Cleveland.

Brine and Ammonia Pipe Covering.

Armstrong Cork and Insulation Co., Pittsburgh, Pa.
Johns-Manville Co., H. W., New York.

Bucket Elevators.

Beaumont Co., R. H., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
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Niles-Bement-Pond Co., New York.
Wood & Co., R. D., Phila., Pa.

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Johnson Bronze Co., New Castle, Pa.

Merchant & Evans Co., Philadelphia, Pa.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Button, Push.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

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Hunt Co., C. W., New York.
Jeffrey Mfg. Co., The, Columbus, O.

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American Steel & Wire Co., Chicago-New York.
General Electric Co., Schenectady, N. Y.

Cableways.

American Steel & Wire Co., Chicago-New York.
Hunt Co., C. W., West New Brighton, N. Y.
Lambert Hoist Eng. Co., Newark, N. J.

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American Steel & Wire Co., Chicago-New York.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

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National Seale Co., Chicopee Falls, Mass.

Calorimeters.

Servo Company, New York.
Schaeffer & Bodenberg Mfg. Co., Brooklyn, N. Y.

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Wellman-Seaver-Morgan Co., Cleveland.

Car Dumpers.

Brown Hoisting Machinery Co., Cleveland, O.
Wellman-Seaver-Morgan Co., Cleveland.

Car Shop Machinery.

Niles-Bement-Pond Co., New York.

Case Hardening Process.

American Gas Furnace Co., New York.

Castings, Brass, Bronze and Composition.

Johnson Bronze Co., New Castle, Pa.
Phosphor Bronze Smelting Co., Phila.

Castings, Die Cast.

Franklin Mfg. Co., H. H., Syracuse, N.Y.

Castings, Iron and Steel.

Caldwell & Son Co., H. W., Chicago.
Loewen-Owens-Reinlacher Co., Hamilton, O.
Jeffrey Mfg. Co., Columbus
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.
Wood & Co., R. D., Phila., Pa.

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Baldwin Chain Mfg. Co., Worcester, Mass.
Caldwell & Sons Co., H. W., Chicago.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg Co., Columbus.
Link Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

Chain Joints.
Morse Chain Co., Ithaca, N. Y.

Checks, Time, Pay and Trade.
Schwerdtle Stamp Co., Bridgeport.

Chucks.
Niles-Bement-Pond Co., New York.

Circuit Breakers.
Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Clutch Pulleys.
Brown Co., A. & F., New York.
Caldwell & Sons Co., H. W., Chicago.
Caldwell Co., W. E., Louisville, Ky.
Merchant & Evans Co., Philadelphia, Pa.
Wellman-Seaver-Morgan Co., Cleveland.

Coal and Ash-Handling Machinery.
Beaumont Co., R. H., Philadelphia.
Brown Hoisting Machinery Co., Cleveland, O.
Caldwell & Sons Co., H. W., Chicago.
Gifford-Wood Co., Hudson, N. Y.
Hayward Co., New York, N. Y.
Hunt Co., C. W., West New Brighton, N. Y.
Industrial Works, Bay City, Mich.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Wellman Seaver-Morgan Co., Cleveland.

Coal Bunkers.
Beaumont Co., R. H., Philadelphia.
Brown Hoisting Machinery Co., Cleveland, O.
Gifford-Wood Co., Hudson, N. Y.

Coal Bridges.
Brown Hoisting Machinery Co., Cleveland, O.
Hunt Co., C. W., New York.
Link Belt Co., Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Wellman Seaver-Morgan Co., Cleveland.

Coal Crushers.
Aero Pulverizer Co., New York.
Beaumont Co., R. H., Philadelphia.
Jeffrey Mfg Co., Columbus, O.

Coal Screens.
Beaumont Co., R. H., Philadelphia.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

Cocks, Gage.
Powell Co., Wm., Cincinnati.
Pratt & Cady Co., Hartford, Conn.

Cold Storage Insulation.
Armstrong Cork and Insulation Co., Pittsburgh, Pa.
Johns-Manville Co., H. W., New York.

Concrete Mixers.
Jeffrey Mfg. Co., Columbus.

Concrete Reinforcement.
North Western Expanded Metal Co., Chicago, Ill.
Truscod Concrete Steel Co., (Kahn Building Products), Detroit, Mich.

Condenser Shells, Welded Steel.
Continental Iron Wks., The, Brooklyn, N. Y.

Condensers.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Machine Co., Pittsburgh.

Continuous Elevators.
Beaumont Co., R. H., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., The, Columbus, O.

Contractors' Cars.
Easton Car & Construction Co., Easton, Pa.
Hunt Co., C. W., New York.
Wellman Seaver-Morgan Co., Cleveland.

Contractors.
Austin Co., Cleveland, O.

Controllers, Electric.
Elec. Controller & Mfg. Co., Cleveland
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., Pittsburgh.

Conveying Machinery.
Beaumont Co., R. H., Philadelphia
Buffalo Forge Co., Buffalo, N. Y.
Caldwell & Son Co., H. W., Chicago.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., C. W., West New Brighton, N. Y.
Jeffrey Mfg Co., Columbus.
Link Belt Co., Chicago, Ill.
Mathews Gravity Carrier Co., Ellwood City, Pa.
National Scale Co., Chicopee Falls, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Wellman Seaver-Morgan Co., Cleveland.

Coolers, Air.
Power Specialty Co., New York.
Sturtevant Co., B. F., Boston, Mass.

Coolers, Oil.
Ericsson-Russell Co., New York, N. Y.

Cooling Systems.
Sturtevant Co., B. F., Boston, Mass.

Cooling Towers.
Cooling Tower Co., New York.
Stocker, George J., St. Louis.

Corkboard Insulation.
Armstrong Cork and Insulation Co., Pittsburgh, Pa.
Johns-Manville Co., H. W., New York.

Corliss Engines.
Allis-Chalmers Mfg. Co., Milwaukee, Wis
Bell Engine Co., Erie, Pa.
Hoosier-Dewees - Bentschler Co., Hammond, O.
Wellman-Seaver-Morgan Co., Cleveland.

Corrugated Furnaces.
Continental Iron Wks., The, Brooklyn, N. Y.

Counters, Production.
Veeder Mfg. Co., Hartford, Conn.

Counters, Speed.
Veeder Mfg. Co., Hartford, Conn.

Counting Machines.
National Scale Co., Chicopee Falls, Mass
Veeder Mfg. Co., Hartford, Conn.

Couplings, Shaft.
Caldwell & Son Co., H. W., Chicago.
Jeffrey Mfg. Co., The, Columbus, O.

Couplings, Flexible.
Electric Controller & Mfg. Co., Cleveland, O.
Francke Co., New Brunswick, N. J.
General Electric Co., Schenectady, N. Y.
Lidgid Engineering Co., Montclair, N. J.
Smith-Serrell Co., Inc., New York.

Cranes.
Brown Hoisting Machinery Co., Cleveland, O.
Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Manning, Maxwell & Moore, New York
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Orton & Steinbrenner Co., Huntington, Ind.
Shaw Electric Crane Co., The, New York
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Wellman-Seaver-Morgan Co., Cleveland.
Wood & Co., R. D., Philadelphia.

Crane Motors.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg Co., Pittsburgh.

Cupolas.
Buffalo Forge Co., Buffalo, N. Y.
Northern Engineering Works, Detroit.

Cutting-Oxy-Acetylene.
Prest-O-Lite Co., Inc., Indianapolis, Ind.

Cutting Off Machines.
Prest-O-Lite Co., Inc., Indianapolis, Ind.

Cylinders.
Graner Tank Works, Wm., East Chicago, Ind.
Continental Iron Wks., The, Brooklyn, N. Y.
National Tube Co., Pittsburgh, Pa.
Wolfe & Sons Co., Wm. B., Oakmont, Pa.
T. A. East Iron Pipe & Ply. Co., New York.

Derricks and Fittings.
Hayward Co., New York, N. Y.
Industrial Works, Bay City, Mich
Northern Engineering Works, Detroit.

Dies, Self-Opening.
Greenfield Tap & Die Corp., Greenfield, Mass.

Doors, Steel.
Edwards Mfg. Co., Cincinnati, O.
Luptons Sons Co., David, Philadelphia, Pa.
Merchant & Evans Co., Philadelphia, Pa.

Draft Gages.
Foxboro Co., The, Foxboro, Mass
Schaeffer & Buelenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Cos., Rochester, N. Y.
Uehling Instrument Co., New York.

Draft, Apparatus.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg. Co., L. J., New York, N. Y.

Drilling Machines.
Ingersoll-Rand Co., New York
Niles-Bement-Pond Co., New York.

Drills, Bench.
Buffalo Forge Co., Buffalo, N. Y.

Drills, Electrical Radial.
General Electric Co., Schenectady, N. Y.
Niles-Bement-Pond Co., New York.

Drills, Rail.
Niles-Bement-Pond Co., New York.

Drinking Water Systems.
American Steel & Wire Co., Chicago, New York.
Armstrong Cork & Insulation Co., Pittsburgh, Pa.
Johns-Manville Co., H. W., New York.

Drives, Chain.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Morse Chain Co., Ithaca, N. Y.

Drives, Gears.
Poole Engineering & Machine Co., Baltimore, Md.
Sturtevant Co., B. F., Boston, Mass.

Drives, Lenix.
Smith & Co., F. L., New York.

Drop Forgings.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Drying Apparatus.
Buffalo Forge Co., Buffalo, N. Y.
Buffalo Foundry & Machine Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg. Co., L. J., New York, N. Y.

Dumps, Automatic.
Beaumont Co., R. H., Philadelphia.
Hunt Co., C. W., New York.

Dynamos.
Allis-Chalmers Mfg. Co., Milwaukee, Wis
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., Columbus
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass
Westinghouse Elec. & Mfg Co., Pittsburgh.

Ejectors.
Watson & McDaniel Co., Philadelphia.

Electric Fault Finders.
Electric Controller & Mfg Co., Cleveland, O.

Electric Heating Apparatus.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg Co., Pittsburgh.

Electric Hoists.
Brown Hoisting Machinery Co., Cleveland, O.
Hunt Co., C. W. New York.
Lambert Hoist Eng. Co., Newark.
Manning, Maxwell & Moore, New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.
Shaw Electric Crane Co., The, New York.
Shepard Elec Crane & Hoist Co., Montour Falls, N. Y.
Wellman-Seaver-Morgan Co., Cleveland.

Electric Light and Power Plants.
General Electric Co., Schenectady, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Electrical Measuring Instruments.
Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.
Johns Manville Co., H. W., New York.
Scott, Bernard, Watt Co., Cleveland, O.
Westinghouse Electric & Mfg Co., Pittsburgh.

Electrical Wires and Cables.
American Steel & Wire Co., Chicago-New York.
General Electric Co., Schenectady, N. Y.

Elevating and Conveying Machinery.
Beaumont Co., R. H., Philadelphia.
Brown Hoisting Machinery Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago.
Hayward Co., New York, N. Y.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Mathews Gravity Carrier Co., Ellwood City, Pa.
National Scale Co., Chicopee Falls, Mass
Northern Engineering Works, Detroit.
Orton & Steinbrenner Co., Huntington, Ind.
Shepard Elec. Crane & Hoist Co., Montour Falls, N. Y.

Elevators.
Caldwell & Son Co., H. W., Chicago.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

Elevator Buckets.
Caldwell & Son Co., H. W., Chicago.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., C. W., West New Brighton, N. Y.
Jeffrey Mfg Co., Columbus, O.

Elevator Motors.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg Co., Pittsburgh.

Elevators, Revolving Portable.
New York Revolving Portable Elevator Co., Jersey City, N. J.

Engineering Instruments.
Allsopp & Sons, Theo., Philadelphia.
Buff & Berger, Boston.
General Electric Co., Schenectady, N. Y.
Foxboro Co., The, Foxboro, Mass.

Engineers, Consulting.
Alberti, R. W. & Co., New York.
Archer, W. G. & Associates, New York.
Arnold Co., Chicago.
Austin Co., Cleveland, O.
Bacon, Earle C., New York.
Baker, Sutton & Harrison, New York.
Cooper, Hugh L., New York.
Ehrlich-Zimmerman, Philadelphia, Pa.
Dodge, Kern, Philadelphia, Pa.
Fales, Inc., R. Y., Chicago.
Gunn, Richards & Co., New York.
Independence Bureau, Philadelphia, Pa.
Keller Pneumatic Tool Co., Fond du Lac, Wis.
Kennedy, Julian, Pittsburgh.
Kidder, W. M., New York.
Knoepfel & Co. C. E., New York.
Krehbiel Co., Chicago, Ill.
Little, Inc., Arthur D., Boston, Mass.
McDonald, Albert, New York, N. Y.
Merchants' Audit & Accounting Co., Inc., New York.
Mitchell, Mendenhall & Co., New York and Chicago

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Engineers, Consulting. (Continued)

Morrison, James E., Detroit, Mich.
Ordnance Engineering Corp., New York
Patterson, Teele & Dennis, New York.
Sewell Weltington & Co., Boston, Mass
Shepard, Geo. H., Buffalo, N. Y.
Smyth-Du, S. H., Pittsburgh, Pa.
Stimpson, H. F., Brooklyn, N. Y.
Stone & Webster Engineering Corp., Boston, Mass.
Uehling, F. F., New York.
Wellman-Seaver-Morgan Co., Cleveland.
Wentcott & Mapes, New Haven, Conn.

Engineers, Electrical.

Lord Electric Co., New York.

Engineers, Industrial.

Austin Co., Cleveland, O.

Engines, Blowing.

Allis-Chalmers Mfg. Co., Milwaukee, Wis
Sturtevant Co., B. F., Boston, Mass.
Wellman-Seaver-Morgan Co., Cleveland.

Engines, Gas and Gasoline.

(See Gas and Gasoline Engines.)

Engines, Hoisting.

Hunt Co., C. W., West New Brighton, N. Y.
Lambert Hoisting Engine Co., Newark, N. J.

Engines, Oil.

Allis-Chalmers Mfg. Co., Milwaukee, Wis
Bessemer Gas Engine Co., Grove City, Pa.
National Transit Co. Shops, Oil City.

Engines, Steam.

Allis-Chalmers Mfg Co., Milwaukee, Wis.
Ames Iron Works, Oswego, N. Y.
Ball Engine Co., Erie, Pa.
Buffalo Forge Co., Buffalo, N. Y.
Gibson Russell Co., New York, N. Y.
Hoosen Owen Rentschler Co., Hamilton, O.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Troy Engine & Machine Co., Troy, Pa.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Mch. Co., Pittsburgh.

Evaporators.

Gibson Russell Co., New York, N. Y.

Excavators.

Brown Hoisting Machinery Co., Cleveland, O.

Exhaust Heads.

Buffalo Forge Co., Buffalo, N. Y
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, O
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Philadelphia.

Expanders, Roller Tube.

Nicholson & Co. Wilkes-Barre, Pa.

Expansion Joints.

Badger & Sons Co., C. B., Boston, Mass.
Gibson Russell Co., New York, N. Y.

Fans, Electric.

Buffalo Forge Co., Buffalo, N. Y.
Carrier Air Conditioning Co., New York.
General Electric Co., Schenectady, N. Y.
Sturtevant Co., B. F., Boston, Mass.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Wing Mfg. Co., L. J., New York, N. Y.
Wood & Co., R. D., Phila., Pa.

Fans, Ventilating.

Buffalo Forge Co., Buffalo, N. Y.
Carrier Air Conditioning Co., New York.
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, Columbus, O.
Power Specialty Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass
Terry Steam Turbine Co., Hartford, Conn.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Wing Mfg. Co., L. J., New York, N. Y.

Feed Water Filters.

Gibson Russell Co., New York, N. Y.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

Feed Water Heater and Purifiers.

Graver Tank Works, Wm., East Chicago, Ind.
Gibson-Russell Co., New York, N. Y.
Hoppes Mfg. Co., Springfield, O
National Pipe Bending Co., New Haven, Conn.
Scaife & Sons Co., Wm. B., Pittsburgh.
Webster & Co., Warren, Camden, N. J.

Felt Roofing.

Barrett Co., New York.
Johns-Manville Co., H. W., New York.

Fences, Wire.

American Fence Construction Co., New York, N. Y.
American Steel & Wire Co., Chicago-New York.
Anchor Post Iron Wks., New York, N. Y.

Fibre Rods, Tubes, Washers, etc.

Diamond State Fibre Co., Bridgeport, Pa.
Johns-Manville Co., H. W., New York

Filter Presses.

Niles-Bement-Pond Co., New York.

Filters.

American Steel & Wire Co., Chicago-New York.
S. F. Bowser & Co., Inc., Fort Wayne, Ind
Graver Tank Works, Wm., East Chicago, Ind
R. I. V. Co., New York, N. Y.
Scaife & Sons C., Wm. B., Pittsburgh.

Fire Doors.

Merchant & Evans Co., Philadelphia, Pa.
Wilson Corp., J. G., New York.

Fire Extinguisher Apparatus.

Johns-Manville Co., H. W., New York.

Fire Hose.

Johns-Manville Co., H. W., New York.

Fireproof Building Materials.

Brown Hoisting Machinery Co., Cleveland, O.
Edwards Mfg. Co., Cincinnati, O.
Johns-Manville Co., H. W., New York.
Maurer & Son, Henry, New York.
Trussed Concrete Steel Co., Detroit, Mich

Flanges, Pipe.

Badger & Sons Co., C. B., Boston, Mass.
National Tube Co., Pittsburgh, Pa.

Flare Lamps, Acetylene.

Prest-O-Lite Co., Inc., Indianapolis, Ind.

Flexible Couplings.

Francke Co., New Bromwick, N. J.
Lloyd Engineering Co., Montclair, N. J.
Smith-Serrell Co., Inc., New York.

Flexible Metal Hose.

American Metal Hose Co., Waterbury, Ct.
Johns-Manville Co., H. W., New York.
Penna Flexible Metallic Tubing Co., Philadelphia, Pa.

Fly Wheels.

Caldwell & Son Co., H. W., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Forges.

Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Iron and Steel.

Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Forming and Bending Machinery.

Niles-Bement-Pond Co., New York.

Foundry Equipment.

Harvard Co., New York, N. Y.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.

Foundry Supplies.

Ingersoll-Rand Co., New York.

Freight Handling Machinery, Electric.

Brown Hoisting Machinery Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, Columbus, O.

Friction Clutches.

Caldwell Co., W. E., Louisville, Ky.
Caldwell & Son Co., H. W., Chicago.
Morchant & Evans Co., Philadelphia, Pa.
Wellman-Seaver-Morgan Co., Cleveland.

Fuel Economizers.

Sturtevant Co., B. F., Hyde Park, Mass

Furnace Builders.

American Gas Furnace Co., New York.
Continental Iron Works, The, Brooklyn.
Kennedy, Julian, Pittsburgh.
Wellman-Seaver-Morgan Co., Cleveland.

Fuses, Electric.

General Electric Co., Schenectady, N. Y.
Johns-Manville Co., New York.

Gages, Cylindrical.

Greenfield Tap & Die Corp., Greenfield, Mass.

Gages, Depth.

Pneumercator Co., New York, N. Y.

Gages, Pressure, Steam, Water.

Foxboro Co., The Foxboro, Mass.
Jenkins Bros., New York.
Pneumercator Co., New York, N. Y.

Gages, Recording.

Foxboro Co., Foxboro, Mass.
Pneumercator Co., New York, N. Y.
Uehling Instrument Co., New York, N. Y.

Gages, Thread.

Greenfield Tap & Die Corporation, Greenfield, Mass.

Galvanometers.

General Electric Co., Schenectady, N. Y.

Gas Furnaces.

American Gas Furnace Co., New York.

Gas Blowers and Exhausters.

Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg Co., L. J., New York, N. Y.

Gas and Gasoline Engines.

Allis-Chalmers Mfg Co., Milwaukee, Wis
Bessemer Gas Engine Co., Grove City, Pa.
General Electric Co., Schenectady, N. Y.
Hooven, Owens-Rentschler Co., Hamilton, O.
Nagle Cortiss Engine Wks., Erie, Pa.
National Transit Pump & Machinery Co., Oil City, Pa.
Westinghouse Mch. Co., Pittsburgh.

Gas Machines and Generators.

Am Gas Furnace Co., New York
Graver Tank Wks., Wm., East Chicago, Ind.

Gas Producers.

Smith-Gas Engineering Co., Lexington, O.
Smythe Co., S. H., Pittsburgh, Pa.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Machine Co., Pittsburgh.
Wood & Co., R. D., Phila., Pa.

Gaskets.

Diamond State Fibre Co., Bridgeport, Pa.
Jenkins Bros., New York
Johns-Manville Co., H. W., New York.

Gasolene Storage Systems.

S. F. Bowser & Co., Inc., Fort Wayne, Ind
Scaife & Sons Co., Wm. B., Oakmont, Pa.

Gear Cutting Machines.

Gleason Works, Rochester, N. Y.

Gears and Gearing.

Ahlsquist-Dever Co., Chicago, Ill.
Caldwell & Son Co., H. W., Chicago.
Diamond State Fibre Co., Bridgeport, Pa.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Gleason Works, Rochester, N. Y.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Poole Engineering & Machine Co., Baltimore, Md.

Gears, Reduction.

Poole Engineering & Machine Co., Baltimore, Md
Sturtevant Co., B. F., Boston, Mass.

Generating Sets.

Allis-Chalmers Mfg. Co., Milwaukee, Wis
General Electric Co., Schenectady, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Terry Steam Turbine Co., Hartford, Conn
Westinghouse Machine Co., Pittsburg

Glass, Wired.

Mississippi Wire Glass Co., New York

Grinding Machines.

General Electric Co., Schenectady, N. Y.
Heinig Mfg. Co., St. Paul, Minn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Landis Tool Co., Waynesboro, Pa.
Link Belt Co., Chicago, Ill.

Grinding and Pulverizing Machinery.

Bonnot Co., Canton, O.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Raymond Bros. Impact Pulverizer Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Hack Saws.

Niles-Bement-Pond Co., New York.

Hammers, Electric.

Heinig Mfg. Co., St. Paul.

Heat Controllers.

American Gas Furnace Co., New York.

Heaters, Oil.

Gibson Russell Co., New York, N. Y.

Heaters, Water.

Gibson Russell Co., New York, N. Y.

Heating Furnaces.

Wellman-Seaver-Morgan Co., Cleveland.

Heating Machines.

American Gas Furnace Co., New York.

Heating and Ventilating Apparatus.

Buffalo Forge Co., Buffalo, N. Y.
Carrier Air Conditioning Co. of Am., New York.
Hitchins & Co., New York
Lord & Burnham Co., Irvington, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Webster & Co., Warren, Camden, N. J.
Wing Mfg Co., L. J., New York, N. Y.

Hoisting Engines and Machinery.

Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
Link Belt Co., Chicago, Ill.
Northern Engineering Works, Detroit.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Wellman-Seaver-Morgan Co., Cleveland.

Hoisting Rope.

American Steel & Wire Co., Chicago-New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., The, Columbus, Ohio.

Hoists, Electric.

Brown Hoisting Machinery Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Hunt Co., C. W., New York.
Lambert Hoist. Eng. Co., Newark.
Link Belt Co., Chicago, Ill.
Manning, Maxwell & Moore, New York.
Niles-Bement-Pond, New York.
Northern Engineering Works, Detroit, Mich.
Shaw Electric Crane Co., The, New York.
Shepard Elec. Crane & Hoist Co., Montour Falls, N. Y.

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Time elapsed—actual working time is the only time that counts. Time wasted—costs you money and does the country no good.

INSTALL THE
CALCULAGRAPH
The Elapsed Time Recorder

—and put a meter on your labor costs. You have a right to know how the time you pay for is spent.

It prints the date, starting and finishing time, and the actual time elapsed, in hours and tenths. One Calculagraph records the time of *all* the workmen in a department. Operates automatically by pulling the handles. Enclosed in a durable metal case.

Write for "Elapsed Time Records." It shows forms used by manufacturers in various industries.

CALCULAGRAPH COMPANY

30 CHURCH STREET *Dept. 11* **New York City**

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The Buyers' Directory

Hose.
American Metal Hose Co., The, Watertown, Conn
Johns-Manville Co., H. W., New York.
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.

Hose, Pneumatic.
Johns-Manville Co., H. W., New York.
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.

Hydraulic Gages.
Foxboro Co., The, Foxboro, Mass.

Hydraulic Machinery.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Hydraulic Presses.
Niles-Bement-Pond Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

Hydraulic Rams.
Power Specialty Co., New York.

Ice Handling Machinery.
Caldwell & Son Co., H. W., Chicago.
Gifford-Wood Co., Hudson, N. Y.
Link Belt Co., Chicago, Ill.

Ice Making and Refrigerating Machinery.
Johns-Manville Co., H. W., New York.

Industrial Lighting.
Cooper Hewitt Electric Co., Hoboken, N.J.

Industrial Railways.
Easton Car & Construction Co., Easton, Pa.
Hunt Co., C. W., New York.
Link Belt Co., Chicago, Ill.

Instruments, Recording.
Foxboro Co., The, Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Martin Metal Works, Erie, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Cos., Rochester, N. Y.
Uehling Instrument Co., New York.

Instruments, Scientific.
Precision Thermometer & Instrument Co., Philadelphia.

Insulating Brick.
Armstrong Cork & Insulation Co., Pittsburgh, Pa.

Insulation, Electric.
Diamond State Fibre Co., Bridgeport, Pa
General Electric Co., Schenectady, N. Y
Johns-Manville Co., H. W., New York.

Jigs and Fixtures.
American Mach. & Fdy. Co., Brooklyn

Keyseaters.
Niles-Bement-Pond Co., New York.

Lace Leather.
The Graton & Knight Mfg. Co., Worcester, Mass.
Williams & Sons, J. B., Dover, N. H.

Lamps, Electric.
Cooper Hewitt Electric Co., Hoboken, N.J
General Electric Co., Schenectady, N. Y
Westinghouse Elec & Mfg Co., Pittsburgh.

Lamps, Vapor.
Cooper-Hewitt Electric Co., Hoboken, N.J

Lathe Mandrels.
Nicholson & Co., Wilkes-Barre, Pa

Lathes.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.

Leather Specialties.
The Graton & Knight Mfg. Co., Worcester, Mass.

Lenix Drive.
Smidth & Co., F. L., New York.

Lifting Magnets.
Orton & Steinbrenner Co., Chicago, Ill.

Limit Stops.
Electric Controller & Mfg. Co., Cleveland.

Locomotive Cranes.
Brown Hoisting Machinery Co., Cleveland, O.
Industrial Works, Bay City, Mich.
Link Belt Co., Chicago, Ill.
Northern Engineering Works, Detroit.
Orton & Steinbrenner Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland.

Locomotives, Industrial.
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Westinghouse Elec & Mfg Co., Pittsburgh.

Lubricating Systems.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.

Machinery, Second Hand.
Electric Controller & Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.

Magnesia.
Magnesia Association of America, The, New York, N. Y.

Malleable Castings.
Jeffrey Mfg. Co., Columbus
Link Belt Co., Chicago, Ill.

Mechanical Soot Blowers.
Diamond Power Specialty Co., Detroit, Mich

Metal Lath.
North Western Expanded Metal Co., Chicago, Ill.
Trussed Concrete Steel Co., (Kahn Building Products), Detroit, Mich.

Meters, Air, Gas, Steam and Waterflow.
Foxboro Co., The, Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hoppes Mfg. Co., Springfield, Ohio.
Metric Metal Works, Erie, Pa.

Meters, Electric.
General Electric Co., Schenectady, N. Y.
Johns-Manville Co., H. W., New York.
Westinghouse Elec. & Mfg. Co., Pittsburgh.

Meters, Oil Measuring.
S. F. Bowser & Co., Inc., Fort Wayne, Ind.

Mill Supplies.
Caldwell & Son Co., H. W., Chicago.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Co., Chicago, Ill.

Milling Machines.
Niles-Bement-Pond Co., New York.

Motor Trucks.
Acme Truck Co., Cadillac, Mich.
Chicago Pneumatic Tool Co., Chicago.
Federal Motor Truck Co., Detroit, Mich
Pierce Arrow Motor Truck Co., Buffalo, N. Y.
Merchant & Evans Co., Philadelphia, Pa.

Motors, Electric.
Allis-Chalmers Mfg Co., Milwaukee, Wis
General Electric Co., Schenectady, N. Y
Jeffrey Mfg. Co., Columbus
Link Belt Co., Chicago, Ill
Ridgway Dynamo & Engine Co., Ridgway, Pa
Westinghouse Elec. & Mfg Co., Pittsburg

Moulding Machines.
Power Specialty Co., New York

Name Plates.
Schaeffer Stamp Co., Bridgeport

Naphtha Gas Machines.
Wellman Seaver Morgan Co., Cleveland.

Ohmmeters.
General Electric Co., Schenectady, N. Y

Oil and Gas Fittings.
National Transit Co., Shops, Oil City, Pa.

Oil Pumps.
S. F. Bowser & Co., Inc., Fort Wayne, Ind.
Buffalo Steam Pump Co., Buffalo, N. Y.
National Transit Pump & Machinery Co., Oil City, Pa
Wood & Co., R. D., Philadelphia, Pa.

Oil Refining Plants.
S. F. Bowser & Co., Inc., Fort Wayne, Ind.
Graver Tank Works, Wm., East Chicago, Ill.

Oil Tanks.
S. F. Bowser & Co., Inc., Fort Wayne, Ind.
Caldwell Co., W. E., Louisville, Ky.
Graver Tank Works, Wm., East Chicago, Ind.
Scaife & Sons, Wm. B., Oakmont, Pa
Wood & Co., R. D., Philadelphia, Pa.

Oxy-Acetylene Welding and Cutting.
Prest-O-Lite Co., Inc., Indianapolis, Ind

Packing, Steam.
Jenkins Bros., New York.
Johns-Manville Co., H. W., New York.

Partitions, Steel.
Lupton Sons Co., David, Philadelphia, Pa.

Patent Attorneys.
Dieterich, C. A., New York.

Penstocks.
Graver Tank Works, Wm., East Chicago, Ind.

Perforated Metals.
Allis-Chalmers Mfg Co., Milwaukee, Wis.
Caldwell & Son Co., H. W., Chicago.
Link Belt Co., Chicago, Ill.

Phosphor Bronze.
Phosphor Bronze Smelt. Co., Phila.

Pile Drivers.
Industrial Works, Bay City, Mich.
Lidgerwood Mfg. Co., New York.

Piling, Creosoted.
Jennison-Wright Co., Toledo, Ohio.

Pinions.
Caldwell & Son Co., H. W., Chicago.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y

Pipe.
Continental Iron Wks., The, Brooklyn, N. Y
Graver Tank Works, Wm., East Chicago, Ind
National Tube Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

Pipe Bends.
National Pipe Bending Co., New Haven

Pipe-Cutting and Threading Machines.
Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Co., Bridgeton, N. J.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Niles-Bement-Pond Co., New York.
Saunders' Sons, Inc., D., Yonkers.

Pipe Coverings.
Armstrong Cork and Insulation Co., Pittsburgh, Pa.
Johns-Manville Co., H. W., New York.
Magnesia Association of America, The, New York, N. Y.

Pipe Fittings.
Badger & Sons Co., C. B., Boston, Mass
Direct Separator Co., Syracuse, N. Y.
Wood & Co., R. D., Philadelphia, Pa.

Pitch, Paving.
Barrett Co., New York.

Planers, Metal.
Niles-Bement-Pond Co., New York

Plants, Chemical.
Austin Co., Cleveland, O

Plants, Power.
Austin Co., Cleveland, O

Plates, Steel.
La Belle Iron Works, Steubenville, O.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.
Keller Pneumatic Tool Co., Fond du Lac, Wis.

Pneumercators.
Pneumercator Co., New York, N. Y.

Portable Drilling Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Portable Elevators.
Economy Engineering, Chicago, Ill.
New York Revolving Portable Elevator Co., Jersey City, N. J.

Portable Floor Cranes.
Brown Hoisting Machinery Co., Cleveland, O.

Power Plant Piping.
National Pipe Bending Co., New Haven, Conn

Power-Transmission Machinery.
Allis-Chalmers Co., Milwaukee, Wis.
Caldwell & Son Co., H. W., Chicago.
General Electric Co., Schenectady
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Poole Engineering & Machine Co., Baltimore, Md.
Smidth Co., F. L., New York.
Wellman Seaver-Morgan Co., Cleveland.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Wood & Co., R. D., Philadelphia.

Presses, Power and Hydraulic.
Niles-Bement-Pond Co., New York.

Presses and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.
Niles-Bement-Pond Co., New York
Pratt & Whitney Co., Hartford.
Wood & Co., R. D., Philadelphia

Pressure Blowers.
American Gas Furnace Co., New York
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y
Ning Mfg. Co., L. J., New York, N. Y

Protective Panels.
Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Pulleys, Shafting and Hangers.
Caldwell & Son Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.

Pulverizing Mills.
Aero Pulverizer Co., New York.
Bonnot Co., Canton, O.
Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

Pumps and Pumping Machinery.
Allis-Chalmers Mfg. Co., Milwaukee, Wis
American Well Works, Aurora, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Cameron Steam Pump Works, New York.
Deming Co., Salem, O.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll Rand Co., New York.
Jamison Engine Co., New Castle, Mass
Lawrence Machine Co., Lawrence, Mass.
Morris Machine Wks., Baldwinsville, N. Y.
Nash Engineering Co., S. Norwalk, Conn.
National Transit Pump & Mch. Co., Oil City, Pa.
Wood & Co., R. D., Philadelphia, Pa.

Pumps, Centrifugal, Turbine and Electric.
Allis-Chalmers Mfg. Co., Milwaukee, Wis
American Well Works, Aurora, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Cameron, A. S., Steam Pump Works, New York
Morris Machine Wks., Baldwinsville, N. Y.
Terry Steam Turbine Co., Hartford, Conn.

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WHEN you install a Ball Corliss Engine you have a unit that you can bank upon in any emergency. The reputation of Ball Engines is built on RESULTS—upon a demonstration of superior ability to meet strenuous demands year in and year out, in reliable and efficient fashion. Ease of operation, low upkeep cost, maintained steam economy—these factors are necessary to stand the test of time, and time is the ultimate test that foresight provides for. That is why the big concerns around the country use Ball Engines. They pay in the long run.

All 'Round BALL *Efficiency*

ENGINE COMPANY

ERIE, PA.

The Twentieth Century Fuel

is powdered coal. Its cost is but a small fraction of the cost of fuel oil. By its use the advantages of complete combustion and close regulation incidental to the use of fuel oil can be secured.

To burn coal without waste—in a flame like that obtained from oil or gas—that can be lengthened or shortened—made oxidizing, reducing or neutral at will—will halve your coal bills and produce better results. It will also permit you to utilize slack coal or culm.

With fuel of all kinds at famine prices, get the last B. T. U. from your coal by installing the

HOLBECK POWDERED COAL SYSTEM

This system is different in many ways: Coal dust thoroughly mixed with a fixed quantity of air is blown through a main distribution line, branches from this line serve each fire and the quantity of coal is controlled by a valve.

The surplus fuel is returned to the starting point, the dust separated from the air and deposited in the fuel bin.

An automatic arrangement controls the speed of the Feed Screw supplying the main line, the supply of coal being automatically increased or decreased in accordance with the demands of the shop.

Fuel bills are cut and the Furnace production is increased by the Holbeck System. *Let us send details.*

THE BONNOT CO., Canton, Ohio

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The Buyers' Directory

Punching and Shearing Machinery.

Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York
Wood & Co., R. D., Philadelphia

Pyrometers.

Bristol Co., Waterbury, Conn
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Philadelphia
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester
Uehling Instrument Co., New York.

Rail Bonds.

American Steel & Wire Co., Chicago-New York
Johns-Manville Co., H. W., New York.

Rail Saws.

Industrial Works, Bay City, Mich.

Railways, Industrial.

Easton Car & Construction Co., Easton, Pa.
Hunt Co., C. W., West New Brighton, N. Y.

Railway Shop Machinery.

Industrial Works, Bay City, Mich.
Niles-Bement-Pond Co., New York
Norwalk Iron Works, The, Norwalk, Conn.
Pratt & Whitney Co., Hartford.

Rawhide Gears.

Foote Bros. Gear & Mach. Co., Chicago, Ill.

Ready Roofing and Siding.

Barrett Co., New York.
Johns-Manville Co., H. W., New York.

Reamers.

Greenfield Tap & Die Corp., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Kelly Reamer Co., Cleveland, O.
Pratt & Whitney Co., Hartford.

Recorders CO_2.

Foxboro Co., The, Foxboro, Mass.
Sarco Co., New York, N. Y.

Recording Gages.

Bristol Co., Waterbury, Conn.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Recording Thermometers.

Bristol Co., Waterbury, Conn.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Philadelphia.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Co., Rochester, N. Y.

Regulators, Automatic Pressure.

Electric Controller & Mfg. Co., Cleveland, O.
Taylor Instrument Co., Rochester, N. Y.

Regulators, Damper.

Wing Mfg. Co., L. J., New York, N. Y.

Regulators, Draft.

Mason Regulator Co., Boston, Mass.

Regulators, Feed Water.

Wing Mfg. Co., L. J., New York, N. Y.

Regulators, Pump.

Mason Regulator Co., Boston, Mass.

Relays, Field Rheostat.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Revolving Portable Elevators.

New York Revolving Portable Elevator Co., Jersey City, N. J.

Rheostats, Motor.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Rivet Busters.

Chicago Pneumatic Tool Co., Chicago.

Riveting Machines.

Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York
Wood & Co., R. D., Philadelphia, Pa.

Roller Bearings.

Norma Co. of America, New York
S. K. F. Ball Bearing Co., Hartford, Conn.

Rolling Doors and Shutters.

Edwards Mfg. Co., Cincinnati, O.
Wilson Corporation, The, New York.

Rolling Mill Machinery.

Niles-Bement-Pond Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Roofing.

Barrett Co., New York
Brown Hoisting Machinery Co., Cleveland, O.
Edwards Mfg. Co., Cincinnati, O.
Johns-Manville Co., H. W., New York
La Belle Iron Wks., Steubenville, O.
Merchant & Evans Co., Philadelphia, Pa.

Roofing Materials.

Barrett Co., New York.
Johns-Manville Co., H. W., New York.
Merchant & Evans Co., Philadelphia, Pa.

Rope, Wire.

Hunt Co., C. W., New York.

Rope Transmission.

American Steel & Wire Co., Chicago, Ill.
Caldwell & Son Co., H. W., Chicago.
Hunt Co., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Chicago, Ill.
Phosphor Bronze Smelting Co., Philadelphia.

Rubber Goods.

Jenkins Bros., New York
Johns-Manville Co., H. W., New York.

Safety Goggles.

Strong-Kennard & Nutt Co., Cleveland, O.

Sash.

Lord & Burnham, Irvington, N. Y.
Lupton's Sons Co., David, Philadelphia, Pa.

Sash Operating Device.

Hitchings & Co., New York.
Lord & Burnham Co., Irvington, N. Y.
Lupton Sons Co., David, Philadelphia, Pa.

Saw-Mill Machinery.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus.

Saws, Hack.

Niles-Bement-Pond Co., New York.

Scales.

Brecknell & Co., H., Paris, France.
Burton Griffiths Co., C. W., London, England.
Electric Weighing Co., New York, N. Y.
Hough, Ellison & Co., Christiana, Norway
National Scale Co., Chicopee Falls, Mass.

Screw Machines.

Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Screw Plates.

Greenfield Tap & Die Corp., Greenfield, Mass.

Screws, Set.

Allen Mfg. Co., Hartford, Conn.

Separators, Pneumatic.

Grissom-Russell Co., New York, N. Y.
Raymond Bros. Impact Pulverizer Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Separators, Steam and Oil.

Direct-Separator Co., Syracuse
Grissom-Russell Co., New York, N. Y.
Hoppes Mfg. Co., Springfield, O.
Nicholson & Co., Wilkes-Barre, Pa.
Watson & McDaniel Co., Philadelphia.
Webster & Co., Warren, Camden, N. J.

Shaft Couplings, Compression.

Nicholson & Co., Wilkes-Barre, Pa.

Shaft Couplings, Flexible.

Electric Controller & Mfg. Co., Cleveland
General Electric Co., Schenectady, N. Y.
Smith-Serrell Co., New York.

Shapers, Metal.

Niles-Bement-Pond Co., New York.

Sheathing Papers.

Johns-Manville Co., H. W., New York.
Barrett Co., New York.

Sheets, Black and Galvanized.

La Belle Iron Wks., Steubenville, O.

Shoe Supplies.

The Graton & Knight Mfg. Co., Worcester, Mass.

Shop Floors.

Ayer & Lord Tie Co., Chicago, Ill.
Jamison-Wright Co., Toledo, Ohio.
Johns-Manville Co., H. W., New York.

Shop Furniture.

New Britain Machine Co., New Britain, Conn.

Shutters, Fire.

Merchant & Evans, Philadelphia, Pa.
Wilson Corporation, The J. G., New York.

Solenoids, Electric.

Electric Controller & Mfg. Co., Cleveland
General Electric Co., Schenectady, N. Y.

Soot Blowers.

Diamond Power Specialty Co., Detroit, Mich.

Special Machinery.

American Mach. & Fdy. Co., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago.
Niles-Bement-Pond Co., New York.

Speed Transformers.

Poole Engineering & Machine Co., Baltimore, Md.

Spiral Conveyers.

Jeffrey Mfg. Co., Columbus, O.
Mathews Gravity Carrier Co., Ellwood City, Pa.

Spray-Nozzel Systems.

Cooling Tower Co., New York
Sturtevant Co., B. F., Boston, Mass.
Uehling Instrument Co., New York.

Sprockets.

Cullman Wheel Co., Chicago.
Diamond Chain & Mfg. Co., Indianapolis Ind.
Link Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

Stack Lining

Johns-Manville Co., New York.

Stacks.

Caldwell Co., W. E., Louisville, Ky.
Graver Tank Works, Wm., East Chicago, Ind.
Smith & Son Co., Sam'l, Paterson, N. J.

Stamps, Steel.

Schwerdtle Stamp Co., Bridgeport.

Stand Pipes.

Caldwell Co., W. E., Louisville, Ky.
Graver Tank Works, Wm., East Chicago, Ind.
Wood & Co., R. D., Philadelphia, Pa.

Starters, Electric Motor.

Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Steam Hammers.

Niles-Bement-Pond Co., New York.

Steam Drivers.

Industrial Works, Bay City, Mich.

Steam-Regulation Appliances.

Jenkins Bros., New York.
Powell Co., Wm., Cincinnati.
Power Specialty Co., New York.
Watson & McDaniel Co., Philadelphia.

Steam Specialties.

Diamond Power Specialty Co., Detroit, Mich.
General Electric Co., Schenectady, N. Y.
Nicholson & Co., Wilkes-Barre, Pa.
Webster & Co., Warren, Camden, N. J.

Steam Traps.

Direct Separator Co., Syracuse, N. Y.
Jenkins Bros., New York.
Johns-Manville Co., New York.
Nicholson & Co., Wilkes-Barre, Pa.
Pratt & Cady Co., Hartford, Conn.
Sarco Company, New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Philadelphia.
Webster & Co., Warren, Camden, N. J.

Steam Turbines.

(See Turbines, Steam.)

Steel Balls.

American Ball Co., Providence.

Steel Pipe.

National Tube Co., Pittsburgh, Pa.
La Belle Iron Wks., Steubenville, O.
Smith & Son Co., Jim. B., Oakmont, Pa.

Steel-Plant Machinery.

Wellman-Seaver-Morgan Co., Cleveland.

Steel Plate Construction.

Graver Tank Works, Wm., East Chicago, Ind.
Smith & Son Co., Wm. B., Oakmont, Pa.

Steel Sash.

Lupton Sons Co., David, Philadelphia, Pa.
Truscon Concrete Steel Co., (Kahn Building Products), Detroit, Mich.

Steel Shelving.

Berger Mfg. Co., Canton, O.
Brecknell & Co., H., Paris, France.
Burton Griffiths Co., C. W., London, England.
Hough, Ellison & Co., Christiana, Norway
Lupton Sons Co., David, Philadelphia, Pa.
National Scale Co., Chicopee Falls, Mass

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Save Labor! Save Material!

In these days of high speed production;
—high cost of materials—shortage of labor;
—lack of manufacturing space and facilities,
there is no room for extravagance.

THE TERRY TURBINE

fills every need for maximum economy because of its simplicity. Terry Turbines are the mechanical exponents of Waste Prevention in the power plant.

They occupy very little space, require no cylinder oil or packing, are vibrationless, economical in steam consumption and operate with a minimum of attention.

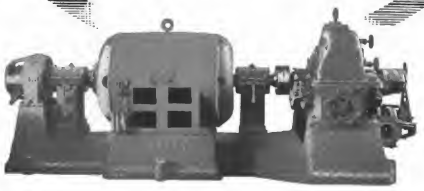
The exhaust steam from the Terry being free from oil, can be used for heating or in manufacturing processes, thus avoiding the use of steam direct from the boilers. Think of this when you consider the increasing cost of coal.

Progressive power plants everywhere realize the value of Terry Turbines for the main unit driving boiler feeders, fans, exciters, gas blowers, condenser auxiliaries, small generator sets and much other rotary apparatus. Where reliability, dependability, economy and long service are the prime requisites

Specify Terry for Your Plant

The Terry Steam Turbine Co.

Hartford, Conn.



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The Buyers' Directory

Stencils.
Schwerdtle Stamp Co., Bridgeport.

Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn
Greenfield Tap & Die Corporation, Greenfield, Mass

Stokers, Mechanical.
Babcock & Wilcox Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Westinghouse Mch. Co., Pittsburgh.

Stops, Cranes.
Electric Controller & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

Storage Batteries.
Westinghouse Mch. Co., Pittsburgh.

Storage Battery Locomotives.
Hunt Co., C. W., West New Brighton, N. Y.

Straps.
The Graton & Knight Mfg. Co., Worcester, Mass

Structural Iron Work.
Northern Engineering Works, Detroit.

Superheaters.
Babcock & Wilcox Co., New York.
Power Specialty Co., New York.

Surveying Instruments.
Buff & Buff Mfg. Co., Boston.

Switchboards, Electric.
Electric Controller & Mfg. Co., Cleveland
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., Pittsburgh.

Tachometers.
Foxboro Co., The, Foxboro, Mass.
Johns-Manville Co., H. W., New York
Schaefer & Budenberg Mfg. Co., Brooklyn, N. Y.

Tank Gages.
Pneumercator Co., New York, N. Y.

Tanks.
Bowser & Co., S. F., Inc., Fort Wayne, Ind
Caldwell Co., W. E., Louisville, Ky
Continental Iron Works, The, Brooklyn, N. Y.
Graver Tank Works, Wm., East Chicago, Ind
Scaife & Sons Co., Wm. B., Pittsburgh
Smith & Son Co., Sam'l, Paterson, N. J
Wood & Co., R. D., Philadelphia, Pa.

Taps and Dies.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Pratt & Whitney Co., Hartford.

Telephones, Factory.
Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.

Temperature Regulator.
Foxboro, Co., The, Foxboro, Mass.
Precision Thermometer & Instrument Co., Philadelphia
Sarco Company, New York
Taylor Instrument Cos., Rochester, N. Y.

Thermometers, Recording.
Precision Thermometer & Instrument Co., Philadelphia.
Taylor Instrument Cos., Rochester, N. Y.

Thermometers, Recording.
Foxboro Co., The, Foxboro, Mass
Schaefer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

Threading Machines.
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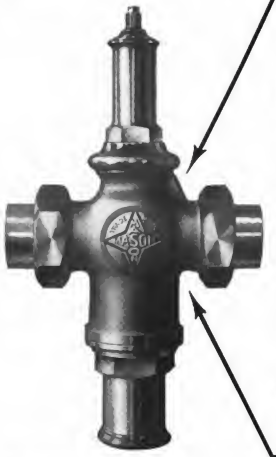

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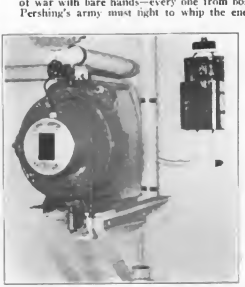

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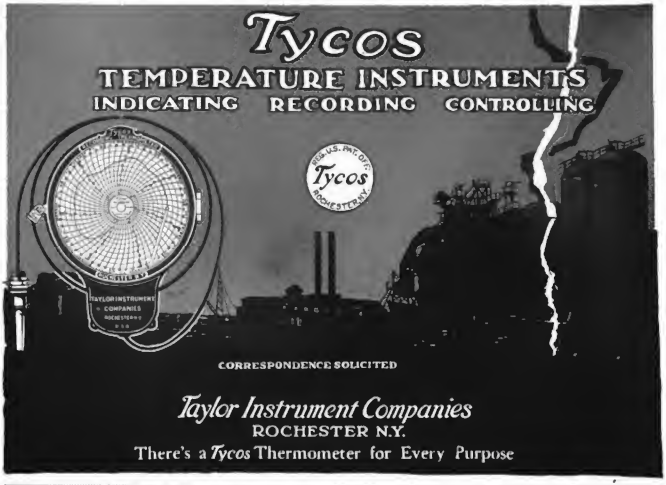

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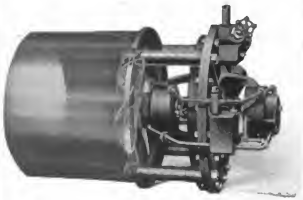

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